United States Air Force
611th Air Support Group/
Civil Engineering Squadron

Elmendorf AFB, Alaska

Final

Risk Assessment

Point Lonely Radar Installation, Alaska

Prepared by:

ICF Technology Incorporated

01 APRIL 1996

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DISCLAIMER NOTICE

PREFACE

This report presents the findings of Risk Assessments at sites located at the Point Lonely radar installation in northern Alaska. The sites were characterized based on sampling and analyses conducted during Remedial Investigation activities performed during August and September 1993. This report was prepared by ICF Technology Incorporated.

This report was prepared between January 1995 and April 1996. Mr. Samer Karmi of the Air Force Center for Environmental Excellence was the Alaska Restoration Team Chief for this task. Dr. Jerome Madden and Mr. Richard Borsetti of the 611th CES/CEVR were the Remedial Project Managers for the project.

Approved:

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Thomas McKinney
Program Director
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NOTICE

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LIST OF ACRONYMS AND ABBREVIATIONS

ADD	Average Daily Dose
Air Force	United States Air Force
ARAR	Applicable or Relevant and Appropriate Requirement
AWQC	Ambient Water Quality Criteria
BCF	Bioconcentration Factors
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
CDI	Chronic Daily Intake
COC	Chemical of Concern
DEW	Distant Early Warning
DRPH	Diesel Range Petroleum Hydrocarbons
ECAO	Environmental Criteria and Assessment Office of EPA
EPA	U.S. Environmental Protection Agency
ERA	Ecological Risk Assessment
GRPH	Gasoline Range Petroleum Hydrocarbons
ha	Hectare
HEAST	Health Effects Assessment Summary Tables
HQ	Hazard Quotient
HSDB	Hazardous Substances Data Bank
HVOCs	Halogenated Volatile Organic Compounds
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
LADD	Lifetime Average Daily Dose
LOAEL	Lowest-Observed Adverse Effect Level
LOEL	Low Observed Effect Level

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

MDEP	Massachusetts Department of Environmental Protection
NOAEL	No Observed Adverse Effect Level
NOEL	No Observed Effect Level
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
RBSL	Risk-Based Screening Level
RfD	Reference Dose
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
RRPH	Residual Range Petroleum Hydrocarbons
SRR	Short-Range Radar
SVOCs	Semi-Volatile Organic Compounds
TPH	Total Petroleum Hydrocarbons
TRVs	Toxicity Reference Values
VOCs	Volatile Organic Compounds
UCL	Upper Confidence Limit
UF	Uncertainty factors
WOE	Weight-of-Evidence

1.0 INTRODUCTION

This document contains the baseline human health risk assessment and the ecological risk assessment (ERA) for the Point Lonely Distant Early Warning (DEW) Line radar installation. Twelve sites at the Point Lonely radar installation underwent remedial investigations (RIs) during the summer of 1993. The Vehicle Storage Area (SS14) was combined with the Inactive Landfill (LF11) because the two sites were essentially co-located and were sampled during the RI as a single unit. Therefore, 11 sites are discussed in this risk assessment. The presence of chemical contamination in the soil, sediments, and surface water at the installation was evaluated and reported in the Point Lonely Remedial Investigation/Feasibility Study (RI/FS) (U.S. Air Force 1996). The analytical data reported in the RI/FS form the basis for the human health and ecological risk assessments. The primary chemicals of concern (COCs) at the 11 sites are diesel and gasoline from past spills and/or leaks, chlorinated solvents, and manganese. The general location of the Point Lonely radar installation is shown in Figure 1-1. The 11 sites investigated and the types of samples collected at each site are presented in Table 1-1.

The purpose of the risk assessment is to evaluate the human health and ecological risks that may be associated with chemicals released to the environment at the 11 sites investigated during the RI. The risk assessment characterizes the probability that measured concentrations of hazardous chemical substances will cause adverse effects in humans or the environment in the absence of remediation. The risk assessment will be used to determine if remediation (site cleanup) is necessary and, if so, to rank sites for remedial action.

1.1 ORGANIZATION OF REPORT

Section 1.0 contains introductory information regarding the installation location and site conditions, and a summary outline of the approach to the human health and ecological risk assessments. Section 2.0 is the Baseline Human Health Risk Assessment, and Section 3.0 is the Ecological Risk Assessment. References are presented in Section 4.0. Section 2.0, Baseline Human Health Risk Assessment, is composed of:

- **Selection of Site Contaminants**. Presents the COCs for human health and describes how they were selected for this risk assessment.

- **Exposure Assessment**. Identifies the pathways by which potential human exposures could occur, and estimates the magnitude, frequency, and duration of those exposures.

- **Toxicity Assessment**. Summarizes the toxicity of the selected COCs and the relationship between magnitude of exposure and the development of adverse health effects.

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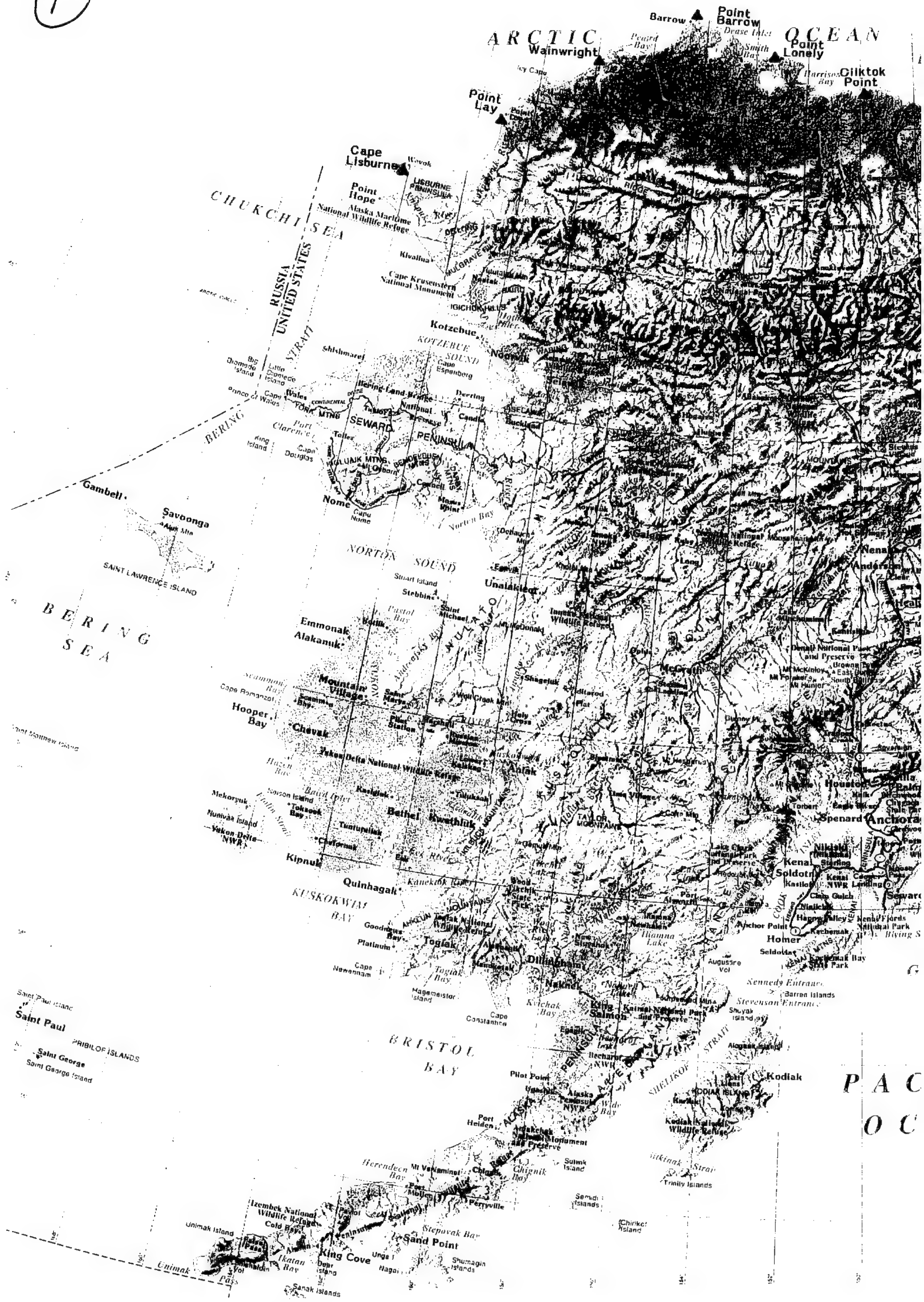
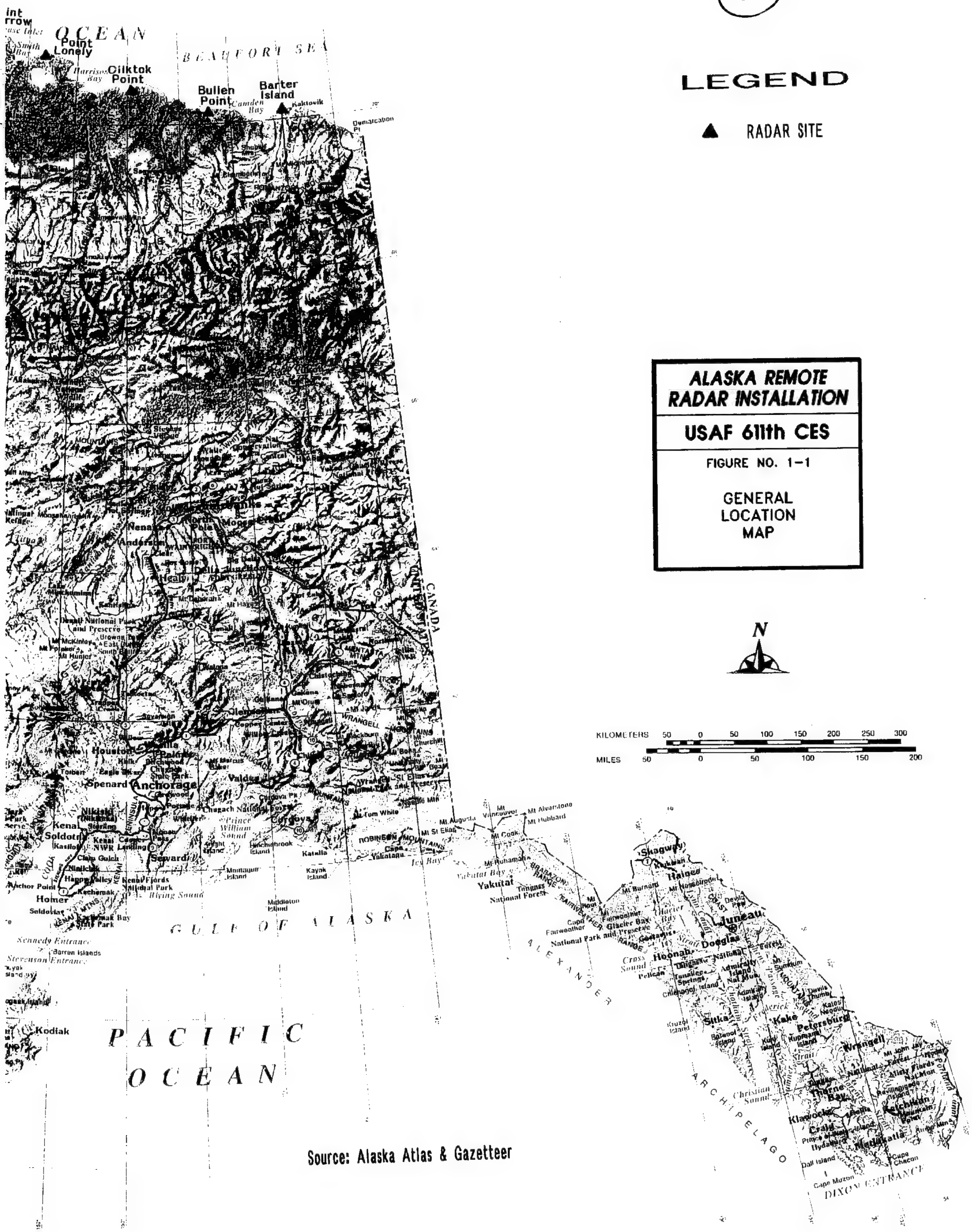


ARCTIC OCEAN
Barrow
Point Barrow
Dease Inlet
Peard Bay
Wainwright
Smith Bay
Point Lonely
Harrison Bay
Cliktok Point
Point Lay
Cape Lisburne
LISBURNE PENINSULA
Point Hope
CHUKCHI SEA
Alaska Maritime National Wildlife Refuge
Kivalina
Cape Krusenstern National Monument
RUSSIA
UNITED STATES
Kotzebue
KOTZEBUE SOUND
Noorvik
Shishmaref
Cape Espenberg
Big Diomede Island
Little Diomede Island
Cape Prince of Wales
Wales
Bering Land Bridge National Preserve
Deering
Candle
Buckland
SEWARD PENINSULA
Port Clarence
King Island
Cape Douglas
Teller
Nome
Cape Nome
Norton Bay
Gambell
Savoonga
SAINT LAWRENCE ISLAND
NORTON SOUND
Stuart Island
Stebbins
Saint Michael
Unalakleet
BERING SEA
Emmonak
Alakanuk
Pastol Bay
Mountain Village
Cape Romanzof
Scammon Bay
Hooper Bay
Chevak
Yukon Delta National Wildlife Refuge
Hazen Bay
Mekoryuk
Nelson Island
Nunivak Island
Toksook Bay
Baird Inlet
Bethel
Kwethluk
Kipnuk
Quinhagak
KUSKOKWIM BAY
Goodnews Bay
Platinum
Togiak
Cape Newenham
Togiak Bay
Hagemeister Island
Dillingham
Naknek
Kvichak Bay
King Salmon
Cape Constantine
BRISTOL BAY
McGrath
Aniak
Holy Cross
TAYLOR MOUNTAINS
Iliamna Lake
Pilot Point
Port Heiden
Aniakchak National Monument and Preserve
Chignik
Perryville
Herendeen Bay
Izembek National Wildlife Refuge
Cold Bay
Unimak Island
Unimak Pass
King Cove
Sand Point
Stepovak Bay
Shumagin Islands
Sanak Islands
Semidi Islands
Chirikof Island
Sutwik Island
Trinity Islands
Kodiak
KODIAK ISLAND
Kodiak National Wildlife Refuge
SHELIKOF STRAIT
Afognak Island
Shuyak Island
Barren Islands
Kennedy Entrance
Stevenson Entrance
Augustine Vol
Homer
Seldovia
Anchor Point
Kenai
Soldotna
Nikiski
Kenai NWR
Seward
Kenai Fjords National Park
Houston
Spenard
Anchorage
Denali National Park and Preserve
Mt McKinley
Nenana
Anderson
Healy
Saint Paul Island
Saint Paul
PRIBILOF ISLANDS
Saint George
Saint George Island
Alaska Peninsula NWR
PAC
OC

2

LEGEND

▲ RADAR SITE



ALASKA REMOTE RADAR INSTALLATION

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FIGURE NO. 1–1

GENERAL LOCATION MAP

Source: Alaska Atlas & Gazetteer

TABLE 1-1. SITES EVALUATED AT POINT LONELY DEW LINE INSTALLATION

SITE NAME	SITE ID NUMBER	SOIL	SEDIMENTS	SURFACE WATER
Sewage Disposal Area	SS01	X	X	X
Drum Storage Area	ST02	X	NA	X
Beach Diesel Tanks	SS03	X	X	X
POL Storage	SS04	X	X	X
Diesel Spills	SS05	X	X	X
Old Dump Site	LF07	X	NA	X
Garage	SS09	X	X	X
Diesel Tank	ST10	X	X	X
Inactive Landfill[a]	LF11	X	X	X
Module Train	SS12	X	X	X
Hangar Pad Area	SS13	X	X	X

X Chemical analyses were performed on these media.
NA No chemical analysis was performed.
a The Vehicle Storage Area (SS14) was combined with the Inactive Landfill (LF11) because the two sites were essentially co-located and were sampled during the RI as a single unit.

- **Risk Characterization**. Integrates the toxicity and exposure assessments to estimate the potential risks to human health from exposure to chemicals in environmental media.

- **Risk Characterization Uncertainty**. Describes the potential shortcomings in the data and the methods used to develop the risk assessment, and the uncertainties in the interpretation of the data and the risk characterization results.

- **Risk Assessment Summary and Conclusions**. Presents a summary and conclusions for the potential human health risks associated with exposure to contaminated media at the 11 sites at the Point Lonely radar installation.

Section 3.0, the Ecological Risk Assessment (ERA), is composed of:

- **Selection of Site Contaminants**. Presents the COCs for ecological receptors and describes how they were selected for the ERA.

- **Ecological Exposure Assessment**. Identifies the potential receptors and representative species, habitat suitability, and exposure pathways.

- **Ecological Toxicity Assessment**. Describes the potential effects of site contaminants on the representative species.

- **Risk Characterization for Ecological Receptors**. Evaluates the likelihood of adverse effects on ecological receptors.

- **Ecological Uncertainty Analysis**. Describes the potential shortcomings in the data and methods used to develop the ERA, and the uncertainties in the interpretation of the data and the ecological risk characterization results.

- **Summary of Ecological Risk**. Presents a summary of ecological risks associated with contaminated media at the 11 sites at the installation.

Appendix A contains the human health risk assessment spreadsheets used to estimate chemical intake, noncancer hazard, and excess lifetime cancer risk. Appendix B consists of toxicology profiles. The exposure equations and calculations for ecological receptors are presented in Appendices C through F. Appendix G contains a summary of RI sampling and analyses and the RI analytical data for all sites from which the COCs were selected and upon which the human health and ecological risk assessments are based.

1.2 RISK ASSESSMENT GUIDANCE DOCUMENTS

The following guidance documents were used to develop the human health and ecological risk assessments:

- *Risk Assessment Guidance for Superfund: Volume 1, Human Health Evaluation Manual (Part A)* (EPA 1989a);

- Region 10 Supplemental Risk Assessment Guidance for Superfund (EPA 1991a);

- *Risk Assessment Guidance for Superfund: Volume 2, Environmental Evaluation Manual* (EPA 1989b);

- General Guidance for ERA at Air Force Bases (MITRE 1990);

- Handbook to Support the Installation Restoration Program (IRP) Statements of Work (U.S. Air Force 1991); and

- Framework for Ecological Risk Assessment (EPA 1992a).

1.3 INSTALLATION DESCRIPTION AND ENVIRONMENTAL SETTING

The Point Lonely radar installation was constructed as an auxiliary station in 1953 and was active until 1989. It was manned from 1958 until 1989. The installation is located at 70°54'N, 153°15'W, between Smith and Harrison Bays on the Beaufort Sea. The general location of the Point Lonely installation is shown in Figure 1-2, and a site plan is shown in Figure 1-3. The installation occupies 2,830 acres and consists of an inactive module train, warehouse, garage, POL tanks, pumphouse, radar antennae, and a 5,000-foot long gravel runway. The module train contained the sanitary wastewater treatment facility, potable water treatment facility, diesel power generators, rotating radar equipment including the radome, recreational facilities, dining facilities, and the incinerator. Parts of the installation were previously owned by Husky Oil Company: the airplane hangar, terminal, two warehouses, control tower, and a tank farm. Currently, Point Lonely is operated as an unmanned short-range radar (SRR) installation. There are no nearby villages.

Geology and Geography. The Point Lonely installation is located on Pitt Point at an elevation ranging from 6 to 24 feet above mean sea level. A large, shallow salt water lagoon lies between the installation and the Beaufort Sea with bluffs on the south side of the lagoon that rise to 20 feet.

Surface water drainage occurs radially away from the installation as sheetflow and ephemeral streams that drain either into larger streams or directly into the Beaufort Sea. The installation lies in swampy terrain with low-centered polygons and several small ponds.

Potable water is obtained for the installation from a lake approximately 3,900 feet away. In the winter this lake freezes completely, and water must be obtained from a larger, deeper lake approximately six miles away. A section of the Smith River approximately two miles south of the installation has been designated as a potential future source of potable water.

The geology of the installation is similar to that of the North Slope in general. A tundra mat overlies a rich organic peaty horizon that contains silt. Permafrost underlies the entire installation.

Permafrost comprises geologic, hydrologic, and meteorologic characteristics that result in permanently frozen ground. Permafrost occurs in both unconsolidated sediments and bedrock. Its distribution is continuous on the Arctic Coastal Plain, and it has a significant impact on the flow of ground and surface water.

Permafrost acts as an impermeable barrier to the movement of groundwater because pore spaces are ice-filled in the zone of saturation. Recharge and discharge are limited to unfrozen channels penetrating the permafrost zone. Permafrost restricts the downward percolation of water and increases runoff, enhancing the creation of lakes and swamps, and also restricts an aquifer's storage capacity and the number of locations from which groundwater may be withdrawn.

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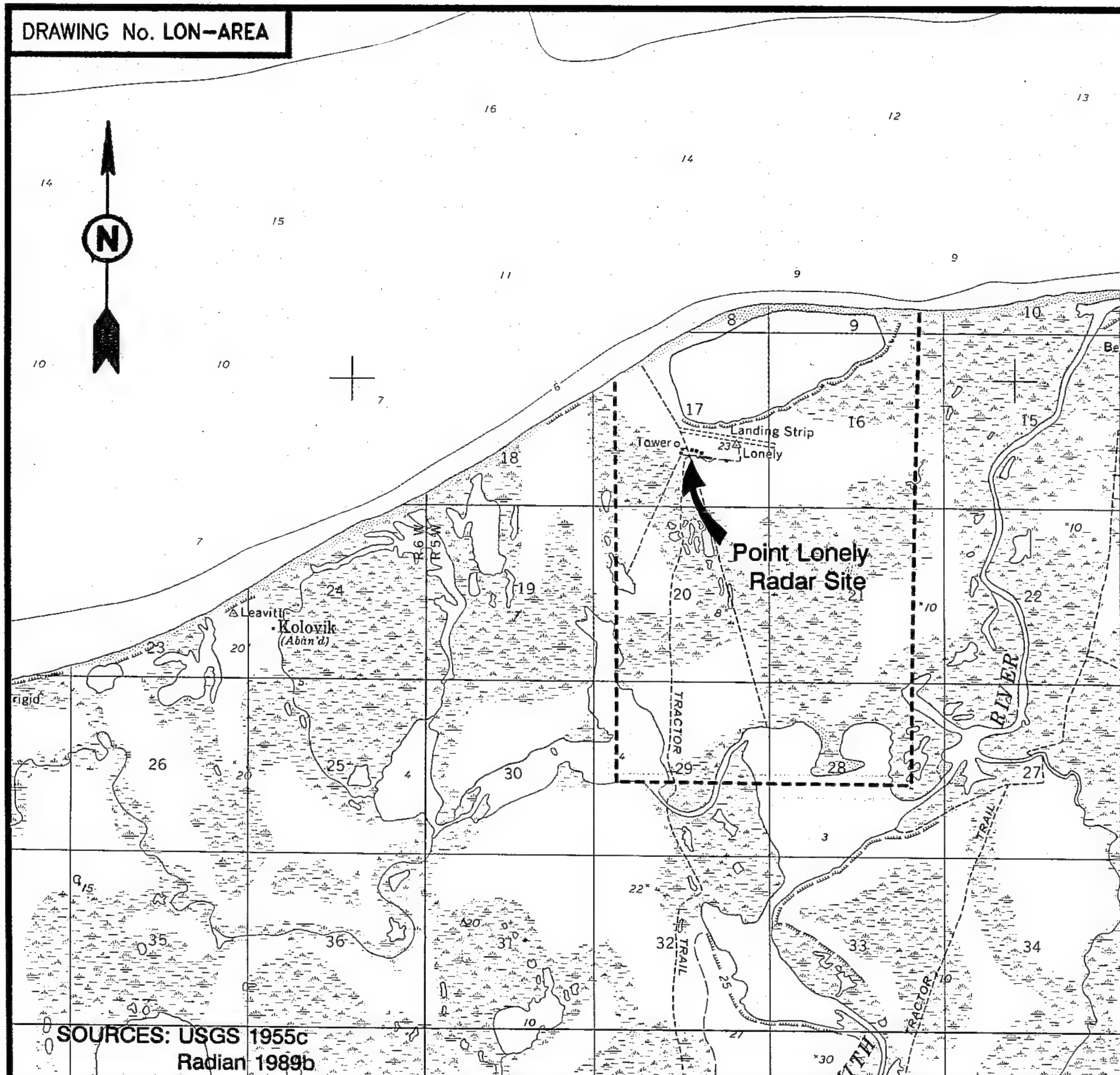
DRAWING No. LON-AREA



POINT LONELY RADAR INSTALLATION

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FIGURE NO. 1-2

AREA LOCATION MAP

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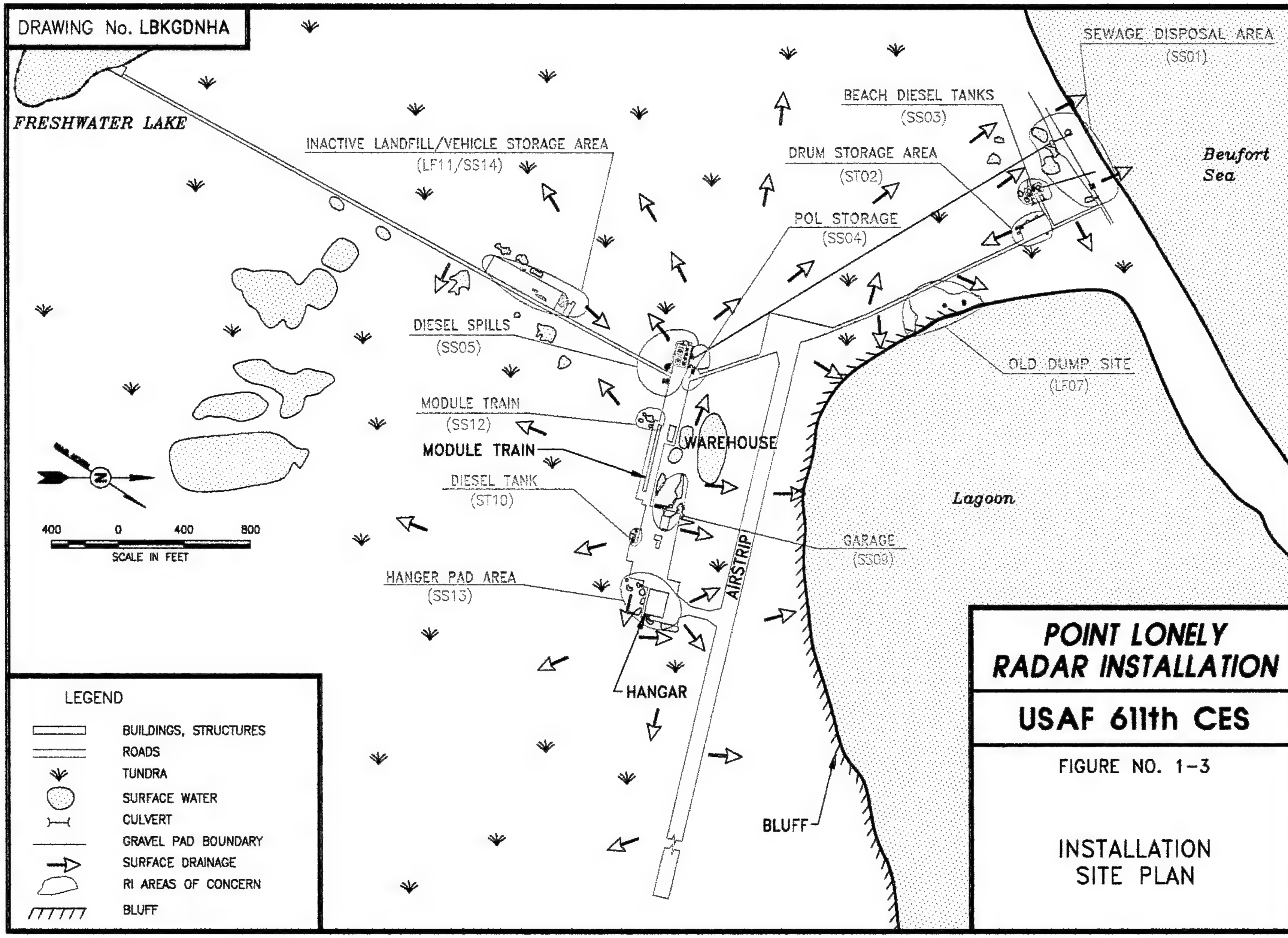

POINT LONELY RADAR INSTALLATION

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FIGURE NO. 1-3

INSTALLATION SITE PLAN

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The interval between permafrost and ground surface is called the active zone because it freezes and thaws with seasonal weather changes. Water may be found in the active zone in the summer months. The thickness of the active zone at Point Lonely varies from approximately one to six feet.

Meteorology. Precipitation at the Point Lonely installation averages four inches per year. Weather recordings from Barrow, Alaska, located 100 miles west of Point Lonely indicate average daily minimum and maximum temperatures of 29°F and 44 °F in the summer, and 25°F and -6°F in the winter. Air quality in the area is expected to be excellent because there are no air pollution sources, and there are persistent light winds along the Arctic Coastal Plain.

Demographics. There are no personnel stationed at the Point Lonely installation, and it is approximately 70 miles from the nearest village (Nuiqsut). Access to the station is by air and sea only, and there are no accommodations or other support facilities for recreational use of the area. The installation is located at the eastern edge of the identified subsistence use area for Barrow, Alaska; therefore, subsistence use of the area around the Point Lonely installation may occur.

1.3.1 Sites Evaluated at the Point Lonely DEW Line Installation

Eleven sites at the installation have been identified from IRP investigations and from the RI/FS project scoping work for evaluation in the risk assessment. These sites are:

- The Sewage Disposal Area (SS01) site is currently inactive and is located on the beach north of the installation and northeast of the Beach Diesel Tanks (SS03) site. The site consists of a beach, gravel road, and tundra on which a pumphouse has been constructed. Two diesel fuel fill pipes, three sewage outfall pipes, and a culvert exist at the site. All diesel fuel lines and sewage outfall pipes are inactive. The western most diesel fuel fill pipe leads from the beach, under the road, through the pumphouse, and to the large diesel tank farm (Husky fuel tanks). The eastern diesel fuel fill pipe leads from the beach, below the road, across the tundra, and to the Beach Diesel Tanks. Three inactive sewage outfall pipes and the culvert are located approximately 100 feet east of the Beach Diesel Tanks fuel fill line and west of the road to the installation.

- The Drum Storage Area (ST02) site is located to the west of the Sewage Disposal Area access road immediately south of the turn off to the Beach Diesel Tanks (SS03). This site is an approximately 45-feet by 100-feet elongate raised gravel pad. The site was used for temporary storage of drummed products. During a 1993 reconnaissance, this site appeared to be relatively clean except for a stained area located on the southwest corner of the gravel pad.

- The Beach Diesel Tanks (SS03) site is located near the beach northwest of the main installation facilities. The site consists of two diesel tanks and associated piping situated in a bermed enclosure on a gravel pad. The inactive tanks were reported cleaned during installation closure activities in 1989. The lined berm

around the tanks was breached during closure activities to ensure that water did not fill the bermed area.

- The POL Storage (SS04) site is a gravel pad area located northeast of the Diesel Spill site and adjacent to the road to the beach. This site is a gravel pad placed on relatively flat tundra that was previously used to store POLs. A diesel fuel pipe from the Beach Diesel Tanks runs along the gravel pad tundra border on the west edge of the site. During the 1993 RI, there was one approximately 3,000 gallon jet fuel tank and several 55-gallon drums of other products stored at the site. A small stained area of limited extent was noted on the gravel pad during the 1993 RI.

- The Diesel Spills (SS05) site is the site of a reported 25,000-gallon spill south of two of the station's diesel tanks. No contamination was visually observed in that area, but south of the large tank farm, formerly the Husky Oil tanks, there was an area exhibiting signs of spilled fuel contamination [ICF Technology Incorporated (ICF) 1993a]). The affected area is approximately three acres; the depth of contamination is variable, but generally is about two feet. The area affected by the spill is gravel pad and tanks. Underlying the pad and natural tundra surface are predominantly fine-grained soils typical of the coastal area, with permafrost below two feet.

- The Old Dump Site (LF07) site is an old landfill site used from approximately 1955 to 1976. After 1976, installation waste disposal was handled by the Husky Oil Company. This inactive landfill is located near the western edge of the lagoon north of the main station facilities and is less than one acre in size. The area has been covered with gravel and graded flat. The lagoon side of the landfill is eroding and some of the debris is exposed. No additional information on the types of waste disposed of at the site or the exact dates of operation is available.

- The Garage (SS09) site is located northeast of the module train. The Garage is an approximately 100-foot by 50-foot building elevated about three feet above the tundra and is surrounded by gravel on all sides. The building was used for vehicle maintenance and storage. Floor drains in this building discharged directly to the tundra beneath the structure and may have received vehicle maintenance waste; however, the site has been inactive since 1989. Culverts lead from under the Garage to the tundra north and west of the gravel pad.

- The Diesel Tank (ST10) site is the former location of a 20,000-gallon fuel tank located east of the module train and southwest of the new SRR technical services building. The site consists of tank supports and the associated pumphouse in a bermed gravel area located on the south edge of the gravel pad. The gravel pad and berm at the site are raised approximately three feet above the tundra, which is located south of the site. No records have indicated historical spills in the area, but previous sampling and analysis indicate the presence of petroleum hydrocarbon contaminated soils.

- The Inactive Landfill (LF11) is located along the west side of the road to Freshwater Lake in the same location as the Vehicle Storage Area (SS14). This landfill was active until the installation closure in 1989. Previous sampling, conducted in 1989 at the site by Air Force contractors, detected petroleum hydrocarbons in the soil (Radian 1989b). A detailed list of source areas and concentrations previously detected is presented in the RI/FS Work Plan (U.S Air Force 1993a). The Vehicle Storage Area (SS14) is co-located with the Inactive Landfill on the road to Freshwater Lake. This site, like the Inactive Landfill, has been regraded and otherwise modified such that its shape in 1993 differed substantially from that indicated on earlier site maps. A second gravel pad north of the largest pad making up the Inactive Landfill site (LF11) was tentatively identified as the Vehicle Storage Area. The surface consisted of relatively clean gravel with occasional, scattered small trash items.

- The Module Train (SS12) site is located at the west end of the Module Train, below the diesel generators and diesel day tanks. The site consists of the gravel pad and tundra, and is in the area of a previous diesel spill.

- The Hangar Pad Area (SS13) site is located approximately 600 feet west of the Garage (SS09) site and south of the airstrip. It consists of an inactive hangar, surrounding gravel pad area, and a 1,000-gallon POL storage tank on the east side of the hangar. The POL tank has been reported to have been cleaned (Radian 1989b).

Table 1-1 contains a summary of the environmental media sampled at each of the sites. The analytical data obtained from these samples form the basis of the human health and ecological risk assessments in this document. Figures of each of the sites are presented in Section 2.0.

The Point Lonely radar installation was investigated to evaluate possible contamination related to United States Air Force (Air Force) activities and historical waste disposal practices at the sites. Twelve sites at the Point Lonely radar installation were determined to be of potential concern based on previous IRP sampling activities, literature search, pre-survey and reconnaissance trips, interviews with station personnel, and information on disposal practices at DEW Line stations. Two sites, the Inactive Landfill (LF11) and the Vehicle Storage Area (SS14), were essentially co-located and are reported in the RI and this risk assessment as a single unit. The sites were investigated during RI/FS activities to confirm the presence or absence of chemical contamination; define the extent and magnitude of confirmed chemical releases; gather adequate data to determine the magnitude of potential risks to human health and the environment; and gather adequate data to identify and select the appropriate remedial actions for sites where apparent risks exceed acceptable limits.

1.4 APPROACH TO HUMAN HEALTH RISK ASSESSMENT

The Point Lonely DEW Line installation presents a unique challenge in the development of a human health risk assessment. Many of the conventional assumptions applied in risk

assessments do not apply to the North Slope of Alaska. Point Lonely is remote and sparsely populated. Native residents, largely Inupiats, follow a lifestyle that includes a significant subsistence component; much of their food consists of mammals (whales, seals, moose, and caribou), aquatic life (arctic char), and birds (ptarmigan and ducks) abundant in this area of the Arctic (Harcharek 1994). The climate is generally harsh, and the soil and surface water are frozen for approximately nine months of the year.

The general approach to the human health risk assessment is to quantify the excess lifetime cancer risk or the noncancer hazard for the site contaminants detected at each of the eleven sites at the installation. The maximum concentration of each chemical detected is used instead of an arithmetic mean or 95th percentile upper confidence limit (UCL) because contamination was detected infrequently and generally found to be of low concentration. Incorporating nondetects into the calculation of an average or UCL when the frequency of positive detects is low tends to yield low and unreliable estimates of contamination. Use of the maximum concentration yields a conservative estimate of risk or hazard.

To the extent possible, site-specific information is incorporated into the development of the exposure assumptions. The harsh climate naturally serves to limit exposure to contaminated soil, sediment, and surface water.

Residential exposure assumptions were used to reflect the upper-bound potential future risk. Several North Slope communities have requested use of inactive buildings at DEW Line installations; therefore, an evaluation using potential residential scenarios at the installations and sites was conducted.

Excess lifetime cancer risk and noncancer hazard are calculated for the soil or sediment ingestion and water ingestion pathways. Other pathways were eliminated from consideration as described in Section 2.2, Human Health Risk Exposure Assessment.

1.5 APPROACH TO ECOLOGICAL RISK ASSESSMENT

The objective of the ERA is to estimate potential impacts to aquatic and terrestrial plants and animals at the Point Lonely radar installation. MITRE (1990) suggests that ERAs should "estimate the potential for occurrence of adverse effects that are manifested as changes in the diversity, health and behavior" of ecosystems. MITRE proposes that this can be accomplished by:

- Estimating the health risk to individual species;
- Evaluating the health of the community of exposed species; and
- Determining the potential adverse effects of contamination over several life cycles of the species under study.

Because this is a screening level assessment, the scope of the ERA is limited to the first task: estimating the health risk to individual species. If a potential health risk to individual species is

identified, further work may be recommended to evaluate the community and life cycle effects. It is important to note that the health risk to an individual species is different from the health risk to an individual within a species. The former refers to population level biology, where the individual is not considered a relevant endpoint. The latter assesses the risks to an individual. In this ERA, the individual is considered only in the case of threatened or endangered species.

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2.0 BASELINE HUMAN HEALTH RISK ASSESSMENT

The purpose of the baseline human health risk assessment for the Point Lonely DEW Line installation is to provide a basis for developing a risk management plan, including remedial action alternatives based on data from the RI/FS. The risk assessment develops numerical estimates of cancer risk and noncancer hazard for each site where sufficient information is available. Where information is not adequate to quantify noncancer hazard or cancer risk for a given COC, a qualitative discussion of the toxicity of that COC is provided in the Toxicity Profiles (Appendix B).

This baseline human health risk assessment addresses issues unique to this location as described in the introduction. It is comprised of six sections:

- Identification of COCs - in which the chemicals detected in environmental samples are compared to risk-based screening levels (RBSLs) and concentrations considered to be applicable or relevant and appropriate requirements (ARARs);

- Exposure assessment - in which the frequency, duration, and magnitude of potential exposures to the COCs are estimated;

- Toxicity assessment - in which the toxicology of the COCs is assessed;

- Risk characterization - in which the potential for adverse health effects in humans as a result of exposure to the COCs is quantified (as appropriate) or qualitatively discussed; and

- Uncertainty assessment - in which the general sources of uncertainty in the risk assessment process and the site-specific sources of uncertainty are discussed.

- Risk assessment summary and conclusions - in which the human health risks at each of the sites are summarized and conclusions regarding the risks are presented.

2.1 IDENTIFICATION OF CHEMICALS OF CONCERN

Chemicals of potential concern to human health were selected for each site at the Point Lonely installation based on comparison of chemical concentrations to naturally-occurring background concentrations, RBSLs, ARARs, and safe levels of essential human nutrients (e.g., calcium, magnesium, sodium, and potassium).

This section discusses the RI sampling strategy and an evaluation of data prior to screening (Section 2.1.1), describes and presents equations for calculating RBSLs (Section 2.1.2), identifies chemicals that are essential human nutrients (Section 2.1.3), describes the collection of background samples (Section 2.1.4), and discusses the selection of COCs (Section 2.1.5).

2.1.1 Evaluation of Analytical Data

The RI sampling strategy at the Point Lonely sites was to characterize the nature and extent of potential contamination at each site. Suspected source areas were sampled to determine the concentrations of contaminants, if any, at the areas likely to have the highest concentrations. Migration pathways from the source areas were sampled to determine the extent, if any, that the contaminants had migrated from the sites. If no discernable pathways were evident, an attempt was made to sample around the source areas to determine the extent of site contaminants. Quick turn-around analyses were conducted on samples from the first sampling event, and a second round of sampling was conducted at those sites where further characterization of the nature and extent of contamination was needed.

Sample types included surface and subsurface soil/sediment samples and surface water samples. In almost all cases, samples were discrete grab samples from one sample location. Surface soil and sediment samples were collected in gravel and tundra areas at or near the ground surface (from ground surface to approximately six inches in depth). Subsurface soil samples were mainly collected in gravel pad areas where unsaturated conditions allowed vertical migration of contaminants. Sediment samples were collected below shallow ponds or streams, or in areas that visually appeared to have been previously covered with water. Surface water samples were collected from ponds, streams, springs, or leachate areas. Surface water samples underwent both total and dissolved metal analyses; however, the total metal analytical results were used in the risk assessment. A summary of the 1993 RI sampling and analyses conducted at the installation is presented in Appendix G.

Before screening for COCs, the results of the RI sampling program were sorted by medium (i.e., soil, sediment, and surface water) and reviewed for quality. The review included an evaluation of the analytical methods used, sample quantitation limits, and qualified data, and a comparison to background levels and laboratory and field blanks. Analytical data were reviewed for completeness, comparability, representativeness, precision, and accuracy. In addition, data validation qualifiers were considered in assessing the quality of the data. The review and validation of analytical data determined that a minimal amount of data was not usable. These data were qualified with an "R" and were not used in the risk assessment.

As outlined in the Risk Assessment Guidance for Superfund (EPA 1989a), site data were compared to available blank (laboratory, field, and trip) data. The data from blanks are presented in Appendix G. In accordance with EPA (1989a), if the detected concentration in a sample was less than 10 times the concentration from blanks for common laboratory contaminants (e.g., acetone, 2-butanone, methylene chloride, toluene, and the phthalate esters) the chemical was not selected for evaluation in the risk assessment. For those organic or inorganic chemicals that are not considered by the U.S. Environmental Protection Agency (EPA) to be common laboratory contaminants (all other compounds), if the detected concentration was less then five times the maximum concentration detected in the blanks, the chemical was not selected for evaluation in the risk assessment.

2.1.2 Risk-Based Screening Levels

An RBSL is a chemical concentration in a particular medium that yields a given cancer risk or hazard quotient (HQ) (e.g., 10^{-7} cancer risk or 0.1 HQ) under a given set of conditions. For Point Lonely, the RBSLs were calculated for soil based on EPA default reasonable maximum exposure (RME) parameters (EPA 1991a). In developing the RBSLs, the most recent toxicity factors available from the Integrated Risk Information System (IRIS) and the Health Effects Assessment Summary Tables (HEAST) were used. IRIS and HEAST are databases of toxicity information for human health risk assessment maintained by the Environmental Criteria and Assessment Office (ECAO) of the EPA. The information presented on IRIS represents the consensus of EPA scientists regarding the toxicity of chemicals released to the environment.

2.1.2.1 Formulae for Calculating RBSLs. The RBSL concentrations were derived using equations in EPA Region 10 guidance (EPA 1991a). The equations are also presented in a slightly different form in the Risk Assessment Guidance for Superfund Volume I, Part B (EPA 1991b). Exposure assessment and risk characterization algorithms for human health risk assessments use site-specific contaminant concentration data, factors describing exposure, and toxicity dose-response values [e.g., reference doses (RfDs) or carcinogen slope factors (SFs)]. These risk assessment algorithms are solved for the concentration term to derive the RBSL for soil and surface water. The algorithms are summarized as follows:

$$\text{Risk} = C \times \left(\frac{CR \times EFD}{BW \times AT}\right) \times SF \quad \text{or} \quad HQ = C \times \left(\frac{CR \times EFD}{BW \times AT}\right) / RfD \qquad \textbf{EQUATION 1, 2}$$

Risk = Target Cancer Risk
C = Concentration
CR = Contact Rate
EFD = Exposure Frequency and Duration
BW = Body Weight

AT = Averaging Time
SF = Slope Factor
HQ = Target Hazard Quotient
RfD = Reference Dose

RBSLs are calculated based on a specific target cancer risk or HQ. EPA (1991a) recommends that a 1×10^{-7} target cancer risk and a target noncancer HQ of 0.1 be used for soil and a 1×10^{-6} risk and 0.1 HQ be used for surface water. The lower target cancer risk is used for screening soil because additional pathways, such as dermal contact and inhalation, are not accounted for by the calculations (EPA 1991a).

Equations (1) and (2) shown above are rearranged to solve for the concentration term (i.e., the RBSL):

$$C = \text{Risk} / \left(\left(\frac{CR \times EFD}{BW \times AT}\right) \times SF \right) \quad \text{or} \quad C = HQ / \left(\left(\frac{CR \times EFD}{BW \times AT}\right) / RfD \right) \qquad \textbf{EQUATION 3, 4}$$

Surface Water Ingestion Equations. Using standard default exposure factors (EPA 1989b) for water ingestion, the equation for cancer risk from drinking water ingestion becomes:

$$\text{Risk} = C\ (\mu g/L) \times 0.001\ mg/\mu g \times \left(\frac{2\ L/day \times 350\ day/year \times 30\ year}{70\ kg \times 70\ year \times 365\ day/year}\right) \times SF_o \qquad \textbf{EQUATION 5}$$

Equation 5 can be rearranged to solve for an RBSL with, for example, a target cancer risk of 10^{-6}:

$$C\ (\mu g/L) = 10^{-6} \times 1{,}000\ \mu g/mg \,/ \left[\left(\frac{2\ L/day \times 350\ day/year \times 30\ year}{70\ kg \times 70\ year\ 365\ day/year}\right) \times SF_o\right] \qquad \textbf{EQUATION 6}$$

For non-carcinogens, the equation for the HQ for drinking water ingestion is:

$$HQ = C\ (\mu g/L) \times 0.001\ mg/\mu g \times \left(\frac{2\ L/day \times 350\ day/year \times 30\ year}{70\ kg \times 30\ year \times 365\ day/year}\right) / RfD_o \qquad \textbf{EQUATION 7}$$

Equation 7 can be rearranged to provide an equation for the concentration that represents an HQ of 0.1 from ingestion:

$$C\ (\mu g/L) = 0.1 \times 1{,}000\ \mu g/mg \,/ \left[\left(\frac{2\ L/day \times 350\ day/year \times 30\ year}{70\ kg \times 30\ year \times 365\ day/year}\right) / RfD_o\right] \qquad \textbf{EQUATION 8}$$

Soil or Sediment Ingestion Equations. The equation for calculating carcinogenic risk from soil or sediment ingestion, combining child (subscript c) and (subscript a) adult exposure, is as follows:

$$\text{Risk} = C\ (mg/kg) \times 0.000001\ kg/mg \times \qquad \textbf{EQUATION 9}$$

$$\left[\left(\left(\frac{200_c\ mg/day \times 350_c\ day/year \times 6\ year}{15_c\ kg \times 365\ day/year}\right) + \left(\frac{100_a\ mg/day \times 350_a\ day/year \times 24\ year}{70_a\ kg \times 365\ day/year}\right)\right) / 70\ year\right] \times SF_o$$

Equation 9 can be rearranged to solve for the concentration that represents a target cancer risk of 10^{-7}:

$$C\ (mg/kg) = 10^{-7} \times 1{,}000{,}000\ mg/kg / \qquad \textbf{EQUATION 10}$$

$$\left[\left(\left(\frac{200_c\ mg/day \times 350_c\ day/year \times 6\ year}{15_c\ kg \times 365\ day/year}\right) + \left(\frac{100_a\ mg/day \times 350_a\ day/year \times 24\ year}{70_a\ kg \times 365\ day/year}\right)\right) / 70\ year\right] \times SF_o$$

For non-carcinogens in soil, Equation 11 is used to calculate the HQ:

$$HQ = C\ (mg/kg) \times 0.000001\ kg/mg \times \left[\left(\frac{200_c\ mg/day \times 350_c\ day/year \times 6\ year}{15_c\ kg \times 365\ day/year} \right) + \left(\frac{100_a\ mg/day \times 350_a\ day/year \times 24\ year}{70_a\ kg \times 365\ day/year} \right) / 30\ year \right] / RfD_o \qquad \textbf{EQUATION 11}$$

Equation 11 can be rearranged to solve for the concentration that represents an HQ of 0.1:

$$C\ (mg/kg) = 0.1 \times 1{,}000{,}000\ mg/kg \; / \left[\left(\left(\left(\frac{200_c\ mg/day \times 350_x\ day/year \times 6\ year}{15_c\ kg \times 365\ day/year} \right) + \left(\frac{100_a\ mg/day \times 350_a\ day/year \times 24\ year}{70_a\ kg \times 365\ day/year} \right) \right) / 30\ year \right) / RfD_o \right] \qquad \textbf{EQUATION 12}$$

2.1.3 Screening of Chemicals by Comparing Maximum Detected Concentrations of Essential Human Nutrients

Based on EPA's guidance (1991a), calcium, magnesium, potassium, iron, and sodium are considered to be essential human nutrients and were eliminated from the human health risk assessment at the screening stage. These chemicals are often detected but are not toxic in humans except at extremely high doses. No quantitative toxicity information is available for these elements from EPA sources; therefore, these metals are not selected as COCs for this risk assessment.

2.1.4 Concentrations of Organic and Inorganic Constituents in Background Samples

One soil, three sediment, and two surface water samples were collected in an area of the radar installation assumed to be unaffected by installation operations. These samples served to determine the background concentrations of naturally occurring organic and inorganic constituents in soil, sediment, and surface water (Figure 2-1). Although some naturally occurring compounds were detected in some of the soil and sediment background samples in the diesel range petroleum hydrocarbons (DRPH), gasoline range petroleum hydrocarbons (GRPH), benzene, toluene, ethylbenzene, and xylene (BTEX), and volatile organic compound (VOC) analyses, the organic concentration in background samples is assumed to be non-detect. This conservative approach was used because it is not possible to determine to what degree, if any, the organic compounds detected in site samples were naturally occurring compounds. Soil and sediment background samples were collected from a depth of zero to six inches.

In order to obtain a representative range of background inorganic (metal) concentrations in soil, sediments, and surface waters of the North Slope, 44 samples (29 soil or sediment and 15 water) from seven North Slope radar installations were collected. In addition to Point Lonely, the installations included Barter Island, Bullen Point, Oliktok Point, Point Barrow, Wainwright, and Point Lay. Approximately four soil or sediment and two surface water background samples were collected and analyzed for metals at each of the seven radar installations.

2.1.5 Selection of Chemicals of Concern

Soil and Sediment. The maximum concentrations of the chemicals detected in soil or sediment samples at the Point Lonely installation and not considered to be essential human nutrients were compared, on a site-by-site basis, to the corresponding background concentrations, RBSLs, and where available, federal or state ARARs. Chemicals detected without an RBSL or ARAR were retained as COCs if concentrations exceeded background levels. A chemical with an RBSL or ARAR was selected as a COC for soil and sediment if the maximum concentration at which the chemical was detected exceeded the corresponding background concentration and the RBSL (based either on cancer risk or noncancer hazard) or ARAR (Table 2-1). Thus, for example, the maximum concentration of DRPH at the Sewage Disposal Area (SS01), 16,000 mg/kg, exceeds the background concentration range and the state ARAR of 500 mg/kg. Therefore, DRPH were selected as a COC for the soils at the Sewage Disposal Area.

The COCs for soil/sediment at each site were compared to background concentrations, RBSLs, and ARARs in Table 2-1. The chemicals retained as COCs exceed background concentrations, and the RBSL or an ARAR. A chemical was not retained if the level detected was less than the corresponding RBSL and ARAR, even though background levels were exceeded. The COCs selected that exceed background levels, but do not have an RBSL or an ARAR are discussed below. The COCs selected at each site that exceed an RBSL, ARAR, or both are discussed in Sections 2.1.5.1 to 2.1.5.5.

Surface Water. The maximum concentrations of the chemicals detected in surface water samples at Point Lonely were compared, on a site-by-site basis, to the corresponding background concentrations, RBSLs, and where available, federal or state ARARs. Chemicals detected without an RBSL or ARAR were retained as COCs if concentrations exceeded background levels. A chemical with an RBSL or ARAR was selected as a COC for surface water if the maximum concentration at which the chemical was detected exceeded the corresponding background concentration, and the RBSL (based either on cancer risk or noncancer hazard) or ARAR (Table 2-1). Thus, for example, the maximum concentration of GRPH in surface water at the POL Storage (SS04) site, 3,000 µg/L, exceeds the background concentration, the RBSL based on cancer risk of 50 µg/L, and the RBSL based on noncancer hazard of 730 µg/L. Therefore, GRPH were selected as a COC for the surface water at the POL Storage (SS04) site.

The COCs for surface water at each site were compared to background concentrations, RBSLs, and ARARs in Table 2-1. The chemicals retained as COCs exceed background concentrations and the RBSL or an ARAR. A chemical was not retained if the level detected was less than the corresponding RBSL and ARAR, even though background levels were exceeded. The COCs selected that exceed background levels, but do not have an RBSL or ARAR are discussed below. The COCs at each site that exceed an RBSL, ARAR, or both, are discussed in Sections 2.1.5.1 to 2.1.5.5.

Chemicals Without RBSLs and ARARs. Several chemicals detected above background levels could not be thoroughly screened because an RBSL could not be calculated and no ARAR was available (Table 2-2). The cancer risk and noncancer hazard for these chemicals cannot, therefore, be quantified. A list of these chemicals is presented in Table 2-2.

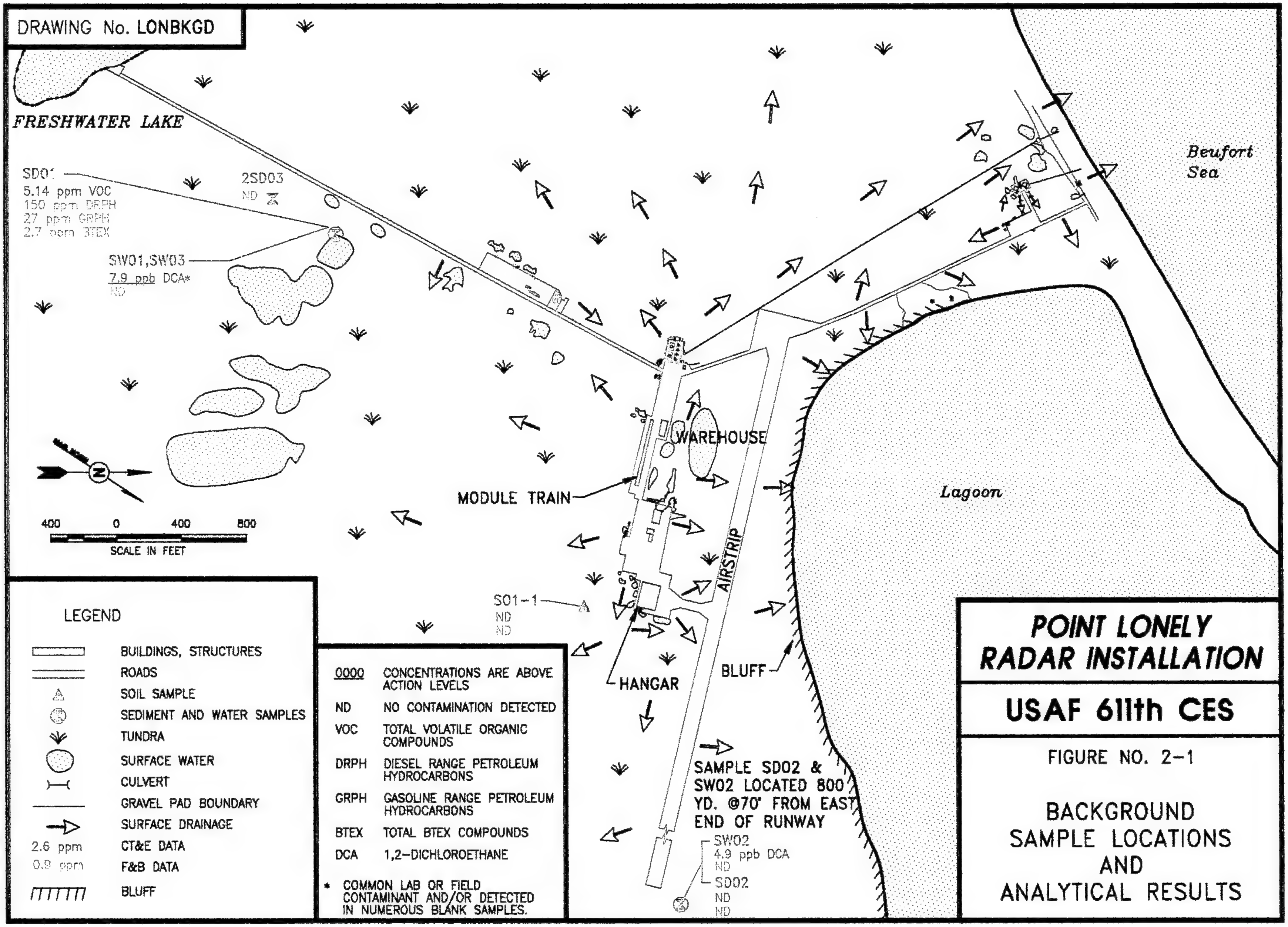

FIGURE NO. 2-1

BACKGROUND SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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TABLE 2-1. IDENTIFICATION OF CHEMICALS OF CONCERN: COMPARISON OF MAXIMUM CONCENTRATIONS TO RISK-BASED SCREENING LEVELS, ARARS, AND BACKGROUND EVALUATION OF CHEMICALS DETECTED AT POINT LONELY

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a]		ARAR[b]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Sewage Disposal Area (SS01)	Soil or Sediments	DRPH	16,000J	mg/kg	<190-150J	--	--	500[c]	Yes
		GRPH	1,000J	mg/kg	<20J-27J	--	--	100[c]	Yes
		Toluene	10J	mg/kg	<0.2-0.2	--	5,400	--	No
		Ethylbenzene	7J	mg/kg	<0.2-0.5	--	2,700	--	No
		Xylenes (total)	32J	mg/kg	<0.4-2.267	--	54,000	--	No
		p-Isopropyltoluene	1.120	mg/kg	<0.300-0.107	--	--	--	Yes*
		n-Butylbenzene	3.51J	mg/kg	<0.300-0.218	--	--	--	Yes*
		sec-Butylbenzene	0.49J	mg/kg	<0.300-0.136	--	--	--	Yes*
		Naphthalene	6.80J	mg/kg	<0.300-0.211	--	1,100	--	No
		1,2,4-Trimethylbenzene	7.82J	mg/kg	<0.300-0.956	--	--	--	Yes*
		1,3,5-Trimethylbenzene	6.89J	mg/kg	<0.300-0.409	--	--	--	Yes*
		2-Methylnaphthalene	6.82	mg/kg	<50-<30	--	--	--	Yes*
	Surface Water	Benzene	2	µg/L	<1	0.617	--	5[d]	Yes
		Toluene	1	µg/L	<1	--	96.5	1,000[e]	No
		Ethylbenzene	1J	µg/L	<1	--	158	700[e]	No
		Xylenes (total)	2.2J	µg/L	<2	--	7,300	10,000[e]	No
		Chloromethane	6.6	µg/L	<1	6.54	--	--	Yes
		Naphthalene	1.1	µg/L	<1	--	150	--	No
		1,3,5-Trimethylbenzene	1.4	µg/L	<1	--	--	--	Yes*
Drum Storage Area (ST02)	Soil	DRPH	1,000J	mg/kg	<190-150J	--	--	500[c]	Yes
		GRPH	90J	mg/kg	<20J-27J	--	--	100[c]	No
		RRPH	1,300	mg/kg	<180-<670	--	--	2,000[c]	No
		Benzene	0.1J	mg/kg	<0.04-<0.5	2.2	--	0.5[c]	No

TABLE 2-1. IDENTIFICATION OF CHEMICALS OF CONCERN: COMPARISON OF MAXIMUM CONCENTRATIONS TO RISK-BASED SCREENING LEVELS, ARARS, AND BACKGROUND EVALUATION OF CHEMICALS DETECTED AT POINT LONELY (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a] CANCER	RBSL[a] NON-CANCER	ARAR[b]	CHEMICAL OF CONCERN
Drum Storage Area	Soil	Toluene	0.4J	mg/kg	<0.2-0.5	--	5,400	--	No
(ST02)	(Continued)	Ethylbenzene	0.9J	mg/kg	<0.2-0.2	--	2,700	--	No
(Continued)		Xylenes (total)	6.3J	mg/kg	<0.4-2.267	--	54,000	--	No
		Tetrachloroethene	2J	mg/kg	<0.04-<0.5	1.23	270	--	Yes
		Aluminum	3,000	mg/kg	1,500-25,000	--	--	--	No
		Barium	92	mg/kg	27-390	--	1,890	--	No
		Calcium	38,000J	mg/kg	360-59,000	--	--	--	No
		Chromium	3	mg/kg	<4.3-47	--	135	--	No
		Iron	10,000	mg/kg	5,400-35,000	--	--	--	No
		Magnesium	22,000J	mg/kg	360-7,400	--	--	--	No
		Manganese	110	mg/kg	25-290	--	3,780	--	No
		Nickel	5.1	mg/kg	4.2-46	--	540	--	No
		Potassium	460	mg/kg	<300-2,200	--	--	--	No
		Sodium	280	mg/kg	<160-680	--	--	--	No
		Vanadium	22	mg/kg	6.3-59	--	189	--	No
		Zinc	13	mg/kg	9.2-95	--	8,100	--	No
	Surface Water	Benzene	500J	μg/L	<1	0.617	--	5[d]	Yes
		Toluene	1,500J	μg/L	<1	--	96.5	1,000[e]	Yes
		Ethylbenzene	38	μg/L	<1	--	158	700[e]	No
		Xylenes (total)	1,600J	μg/L	<2	--	7,300	10,000[e]	No
		Barium	160	μg/L	<50-93	--	256	2,000[g]	No
		Calcium	57,000	μg/L	4,500-88,000	--	--	--	No

TABLE 2-1. IDENTIFICATION OF CHEMICALS OF CONCERN: COMPARISON OF MAXIMUM CONCENTRATIONS TO RISK-BASED SCREENING LEVELS, ARARS, AND BACKGROUND EVALUATION OF CHEMICALS DETECTED AT POINT LONELY (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a] CANCER	RBSL[a] NON-CANCER	ARAR[b]	CHEMICAL OF CONCERN
Drum Storage Area	Surface Water	Iron	380	µg/L	180-2,800	--	--	--	No
(ST02)	(Continued)	Magnesium	48,000	µg/L	<5,000-53,000	--	--	--	No
(Continued)		Manganese	55	µg/L	<50-510	--	18.3	--	No
		Sodium	110,000J	µg/L	8,400-410,000	--	--	--	No
Beach Diesel Tanks	Soil or Sediment	DRPH	15,200J	mg/kg	<190-150J	--	--	500[c]	**Yes**
(SS03)		GRPH	150	mg/kg	<20J-27J	--	--	100[c]	**Yes**
		Toluene	0.033	mg/kg	<0.2-<0.5	--	5,400	--	No
		Ethylbenzene	0.3	mg/kg	<0.2-0.5	--	2,700	--	No
		Xylenes (total)	1.5	mg/kg	<0.4-2.267	--	54,000	--	No
		Naphthalene	0.039	mg/kg	<0.300-0.211	--	1,100	--	No
		1,2,4-Trimethylbenzene	0.174	mg/kg	<0.300-0.956	--	--	--	**Yes***
		1,3,5-Trimethylbenzene	0.071	mg/kg	<0.300-0.409	--	--	--	**Yes***
	Surface Water	All surface water samples were Non Detect							
POL Storage	Soil or Sediment	GRPH	64J	mg/kg	<20J-27J	--	--	100[c]	No
(SS04)		Benzene	1.6	mg/kg	<0.04-<0.5	2.2	--	0.5[c]	**Yes**
		Toluene	1.4	mg/kg	<0.2-0.5	--	5,400	--	No
		Ethylbenzene	2.0	mg/kg	<0.2-0.2	--	2,700	--	No
		Xylenes (total)	2.5J	mg/kg	<0.4-2.267	--	54,000	--	No
		Trichloroethene	24	mg/kg	<0.04-<0.5	5.8	--	--	**Yes**
		Tetrachloroethene	6.7J	mg/kg	<0.04-<0.5	1.23	270	--	**Yes**
		Aluminum	2,400	mg/kg	1,500-25,000	--	--	--	No
		Barium	72	mg/kg	27-390	--	1,890	--	No
		Calcium	45,000	mg/kg	360-59,000	--	--	--	No

TABLE 2-1. IDENTIFICATION OF CHEMICALS OF CONCERN: COMPARISON OF MAXIMUM CONCENTRATIONS TO RISK-BASED SCREENING LEVELS, ARARS, AND BACKGROUND EVALUATION OF CHEMICALS DETECTED AT POINT LONELY (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a]		ARAR[b]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
POL Storage (SS04) (Continued)	Soil or Sediment (Continued)	Chromium	3.4	mg/kg	<4.3-47	–	135	–	No
		Copper	3.2	mg/kg	<2.7-45	–	999	–	No
		Iron	11,000	mg/kg	5,400-35,000	–	–	–	No
		Magnesium	25,000	mg/kg	360-7,400	–	–	–	No
		Manganese	130	mg/kg	25-290	–	3,780	–	No
		Nickel	5.1	mg/kg	4.2-46	–	540	–	No
		Potassium	420	mg/kg	<300-2,200	–	–	–	No
		Sodium	140	mg/kg	<160-680	–	–	–	No
		Vanadium	10	mg/kg	6.3-59	–	189	–	No
		Zinc	12	mg/kg	9.2-95	–	8,100	–	No
	Surface Water	GRPH	3,000J	µg/L	<1,000	50	730	–	**Yes**
		Benzene	562	µg/L	<1	0.617	–	5[d]	**Yes**
		cis-1,2-Dichloroethene	1020	µg/L	<1	–	36.5	70[e]	**Yes**
		Methylene Chloride	161	µg/L	<1	6.30	173	5[h]	**Yes**
		Tetrachloroethene	1,830	µg/L	<1	1.43	36.5	5[e]	**Yes**
		Trichloroethene	285	µg/L	<1	–	–	5[d]	**Yes**
		Ethylbenzene	13J	µg/L	<1	–	158	700[e]	No
		Toluene	1,220	µg/L	<1	–	96.5	1,000[e]	**Yes**
		Xylenes (total)	518	µg/L	<2	–	7,300	10,000[e]	No
		Phenol	27.6J	µg/L	<10.2-<11	–	2,190	–	No
		4-Methylphenol	110	µg/L	<10.2-<11	–	18.3	–	**Yes**
		Naphthalene	18.8J	µg/L	<0.3-<11	–	150	–	No
		Aluminum	130	µg/L	<100-350	–	–	–	No

TABLE 2-1. IDENTIFICATION OF CHEMICALS OF CONCERN: COMPARISON OF MAXIMUM CONCENTRATIONS TO RISK-BASED SCREENING LEVELS, ARARS, AND BACKGROUND EVALUATION OF CHEMICALS DETECTED AT POINT LONELY (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a] CANCER	RBSL[a] NON-CANCER	ARAR[b]	CHEMICAL OF CONCERN
POL Storage (SS04)	Surface Water	Barium	340	µg/L	<50-93	–	256	2,000[l]	Yes
(Continued)	(Continued)	Calcium	95,000J	µg/L	4,500-88,000	–	–	–	No
		Iron	2,600	µg/L	180-2,800	–	–	–	No
		Magnesium	35,000	µg/L	<5,000-53,000	–	–	–	No
		Manganese	3,100	µg/L	<50-510	–	18.3	–	Yes
		Potassium	8,300	µg/L	<5,000	–	–	–	No
		Sodium	83,000	µg/L	8,400-410,000	–	–	–	No
Diesel Spills	Soil or Sediment	DRPH	4,300J	mg/kg	<190-150J	–	–	500[c]	Yes
(SS05)		GRPH	120J	mg/kg	<20J-27J	–	–	100[c]	Yes
		RRPH	420	mg/kg	<180-<670	–	–	2,000[c]	No
		Benzene	1.2J	mg/kg	<0.04-<0.5	2.2	–	0.5[c]	Yes
		Toluene	2.0	mg/kg	<0.2-0.5	–	5,400	–	No
		Ethylbenzene	3	mg/kg	<0.2-0.2	–	2,700	–	No
		Xylenes (Total)	7.0J	mg/kg	<0.4-2.267	–	54,000	–	No
	Surface Water	GRPH	240J	µg/L	<50-<100	50	730	–	Yes
		Benzene	21	µg/L	<1	0.617	–	5[d]	Yes
		Ethylbenzene	10J	µg/L	<1	–	158	700[e]	No
		Xylenes (total)	46J	µg/L	<2	–	7,300	10,000[e]	No
		Chloromethane	2.3J	µg/L	<1	6.54	–	–	No
		1,2-Dichloroethane	4.4B	µg/L	4.9-7.9	0.934	–	5[d]	No
Old Dump Site	Soil	DRPH	270J	mg/kg	<190-150J	–	–	500[c]	No
(LF07)		RRPH	5,900	mg/kg	<180-<670	–	–	2,000[c]	Yes
		Barium	65	mg/kg	27-390	–	1,890	–	No

TABLE 2-1. IDENTIFICATION OF CHEMICALS OF CONCERN: COMPARISON OF MAXIMUM CONCENTRATIONS TO RISK-BASED SCREENING LEVELS, ARARS, AND BACKGROUND EVALUATION OF CHEMICALS DETECTED AT POINT LONELY (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a] CANCER	RBSL[a] NON-CANCER	ARAR[b]	CHEMICAL OF CONCERN
Old Dump Site	Soil	Calcium	53,000J	mg/kg	360-59,000	--	--	--	No
(LF07)	(Continued)	Iron	8,200	mg/kg	5,400-35,000	--	--	--	No
(Continued)		Magnesium	30,000J	mg/kg	360-7,400	--	--	--	No
		Manganese	110	mg/kg	25-290	--	3,780	--	No
		Nickel	3.7	mg/kg	4.2-46	--	540	--	No
		Potassium	370	mg/kg	<300-2,200	--	--	--	No
		Sodium	120	mg/kg	<160-680	--	--	--	No
		Vanadium	15	mg/kg	6.3-59	--	189	--	No
		Zinc	7.5	mg/kg	9.2-95	--	8,100	--	No
	Surface Water	Barium	170	µg/L	<50-93	--	256	2,000[g]	No
		Calcium	80,000	µg/L	4,500-88,000	--	--	--	No
		Iron	11,000	µg/L	180-2,800	--	--	--	No
		Magnesium	44,000	µg/L	<5,000-53,000	--	--	--	No
		Manganese	270	µg/L	<50-510	--	18.3	--	No
		Sodium	130,000J	µg/L	8,400-410,000	--	--	--	No
Garage (SS09)	Soil/Sediment	DRPH	16,000J	mg/kg	<190-150J	--	--	500[c]	**Yes**
		GRPH	400J	mg/kg	<20J-27J	--	--	100[c]	**Yes**
		RRPH	10,000	mg/kg	<180-<670	--	--	2,000[c]	**Yes**
		Benzene	0.28J	mg/kg	<0.04-<0.5	2.2	--	0.5[c]	No
		Toluene	0.74	mg/kg	<0.2-0.2	--	5,400	--	No
		Ethylbenzene	6	mg/kg	<0.2-0.5	--	2,700	--	No
		Xylenes (Total)	30J	mg/kg	<0.4-2.267	--	54,000	--	No
		Tetrachloroethene	18J	mg/kg	<0.04-<0.5	1.23	270	--	**Yes**

TABLE 2-1. IDENTIFICATION OF CHEMICALS OF CONCERN: COMPARISON OF MAXIMUM CONCENTRATIONS TO RISK-BASED SCREENING LEVELS, ARARS, AND BACKGROUND EVALUATION OF CHEMICALS DETECTED AT POINT LONELY (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a] CANCER	RBSL[a] NON-CANCER	ARAR[b]	CHEMICAL OF CONCERN
Garage (SS09) (Continued)	Soil or Sediment (Continued)	Trichloroethene	0.5J	mg/kg	<0.04-<0.5	5.8	–	–	No
		Naphthalene	0.173	mg/kg	<0.300-0.211	–	1,100	–	No
		Carbon Tetrachloride	0.05J	mg/kg	<0.04-<0.5	0.492	18.9	–	No
		1,2,4-Trimethylbenzene	0.098	mg/kg	<0.300-0.956	–	–	–	**Yes***
		1,3,5-Trimethylbenzene	0.227	mg/kg	<0.300-0.409	–	–	–	**Yes***
		Aluminum	2,900	mg/kg	1,500-25,000	–	–	–	No
		Barium	86	mg/kg	27-390	–	1,890	–	No
		Calcium	130,000	mg/kg	360-59,000	–	–	–	No
		Copper	12	mg/kg	<2.7-45	–	999	–	No
		Iron	15,000	mg/kg	5,400-35,000	–	–	–	No
		Magnesium	72,000	mg/kg	360-7,400	–	–	–	No
		Manganese	200	mg/kg	25-290	–	3,780	–	No
		Nickel	7	mg/kg	4.2-46	–	540	–	No
		Potassium	640	mg/kg	<300-2,200	–	–	–	No
		Sodium	310	mg/kg	<160-680	–	–	–	No
		Vanadium	26	mg/kg	6.3-59	–	189	–	No
		Zinc	19	mg/kg	9.2-95	–	8,100	–	No
	Surface Water	Benzene	2J	µg/L	<1	0.617	–	5[d]	**Yes**
		Toluene	6	µg/L	<1	–	96.5	1,000[e]	No
		Xylenes (total)	6J	µg/L	<2	–	7,300	10,000[e]	No
		Barium	290	µg/L	<50-93	–	256	2,000[g]	**Yes**
		Calcium	46,000	µg/L	4,500-88,000	–	–	–	No

TABLE 2-1. IDENTIFICATION OF CHEMICALS OF CONCERN: COMPARISON OF MAXIMUM CONCENTRATIONS TO RISK-BASED SCREENING LEVELS, ARARS, AND BACKGROUND EVALUATION OF CHEMICALS DETECTED AT POINT LONELY (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a]		ARAR[b]	CHEMICAL OF CONCERN
						CANCER	NON-CANCER		
Garage (SS09)	Surface Water	Iron	1,400	µg/L	180-2,800	--	--	--	No
(Continued)	(Continued)	Magnesium	46,000	µg/L	<5,000-53,000	--	--	--	No
		Potassium	11,000	µg/L	<5,000	--	--	--	No
		Sodium	150,000J	µg/L	8,400-410,000	--	--	--	No
Diesel Tank	Soil	DRPH	900J	mg/kg	<190-150J	--	--	500[c]	**Yes**
(ST10)		GRPH	380J	mg/kg	<20J-27J	--	--	100[c]	**Yes**
		Benzene	0.1J	mg/kg	<0.04-<0.5	2.2	--	0.5[c]	No
		Xylenes (Total)	0.2J	mg/kg	<0.4-2.0	--	54,000	--	No
		1,3,5-Trimethylbenzene	0.284	mg/kg	<0.300-0.409	--	--	--	**Yes***
	Surface Water	1,2-Dichloroethane	2B	µg/L	4.9-7.9	0.934	--	5[d]	No
Inactive Landfill	Soil	GRPH	8J	mg/kg	<20J-27J	--	--	100[c]	No
(LF11)		Ethylbenzene	0.2	mg/kg	<0.2-0.2	--	2,700	--	No
		Xylenes (total)	1.2	mg/kg	<0.4-2.267	--	54,000	--	No
		Aluminum	4,300	mg/kg	<1,500-25,000	--	--	--	No
		Barium	110	mg/kg	28-390	--	1,890	--	No
		Calcium	50,000	mg/kg	360-59,000	--	--	--	No
		Chromium	9.0J	mg/kg	<4.3-47	--	135	--	No
		Copper	4.7	mg/kg	<2.7-45	--	999	--	No
		Iron	12,000	mg/kg	5,400-35,000	--	--	--	No
		Magnesium	29,000	mg/kg	360-7,400	--	--	--	No
		Manganese	130	mg/kg	25-290	--	3,780	--	No
		Nickel	6.9	mg/kg	4.2-46	--	540	--	No
		Potassium	410J	mg/kg	<300-2,200	--	--	--	No

TABLE 2-1. IDENTIFICATION OF CHEMICALS OF CONCERN: COMPARISON OF MAXIMUM CONCENTRATIONS TO RISK-BASED SCREENING LEVELS, ARARS, AND BACKGROUND EVALUATION OF CHEMICALS DETECTED AT POINT LONELY (CONTINUED)

SITE	MATRIX	CHEMICAL DETECTED	MAXIMUM CONCENTRATION	UNITS	BACKGROUND RANGE	RBSL[a] CANCER	RBSL[a] NON-CANCER	ARAR[b]	CHEMICAL OF CONCERN
Inactive Landfill	Soil	Sodium	320J	mg/kg	<160-680	--	--	--	No
(LF11)	(Continued)	Vanadium	23	mg/kg	6.3-59	--	189	--	No
(Continued)		Zinc	14	mg/kg	9.2-95	--	8,100	--	No
	Surface Water	GRPH	200J	µg/L	<50-<100	50	730	--	**Yes**
		Benzene	4	µg/L	<1	0.617	--	5[d]	**Yes**
		Toluene	17	µg/L	<1	--	96.5	1,000[e]	No
		Xylenes (total)	7J	µg/L	<2	--	7,300	10,000[e]	No
		Barium	350	µg/L	<50-93	--	256	2,000[g]	**Yes**
		Calcium	97,000	µg/L	4,500-88,000	--	--	--	No
		Iron	1,500	µg/L	180-2,800	--	--	--	No
		Magnesium	41,000	µg/L	<5,000-53,000	--	--	--	No
		Manganese	220	µg/L	<50-510	--	18.3	--	No
		Potassium	5,700	µg/L	<5,000	--	--	--	No
		Sodium	63,000J	µg/L	8,400-410,000	--	--	--	No
Module Train	Soil	RRPH	560	mg/kg	<180-<670	--	--	2,000[c]	No
(SS12)		Styrene	0.08	mg/kg	<0.300-<0.500	--	5,400	--	No
	Surface Water	Toluene	1.6	µg/L	<1	--	96.5	1,000[e]	No
Hangar Pad Area	Soil or Sediment	DRPH	190J	mg/kg	<190-150J	--	--	500[c]	No
(SS13)		GRPH	40J	mg/kg	<20J-27J	--	--	100[c]	No
		RRPH	220	mg/kg	<180-<670	--	--	2,000[c]	No
	Surface Water	Toluene	3	µg/L	<1	--	96.5	1,000[e]	No
		Ethylbenzene	2	µg/L	<1	--	158	700[e]	No
		Xylenes (total)	18J	µg/L	<2	--	7,300	10,000[e]	No

TABLE 2-1. IDENTIFICATION OF CHEMICALS OF CONCERN: COMPARISON OF MAXIMUM CONCENTRATIONS TO RISK-BASED SCREENING LEVELS, ARARS, AND BACKGROUND EVALUATION OF CHEMICALS DETECTED AT POINT LONELY (CONTINUED)

*	Chemicals without an RBSL or ARAR are considered chemicals of potential concern and are discussed in Section 2.1.5.
a	Risk-Based Screening Level.
b	Applicable or Relevant and Appropriate Requirement.
c	ADEC 1991.
d	MCL, 52 FR 25690 (08 July 1987).
e	MCL, 56 FR 3526 (30 January 1991).
f	ADEC 1991.
g	MCL, 56 FR 30266 (01 January 1991).
h	MCL, 57 FR 31776 (17 July 1992).
i	55 FR 30798-Proposed Rule RCRA Corrective Action for SWMUs 40 CFR [Section 264.521 (a)(2)(i-iv)] Health-Based Criteria for Systematic Toxicant.
B	The analyte was less than five times the range of the concentrations detected in background surface water samples and equipment blanks; therefore, 1,2,-dichloroethane is not considered a COC.
J	Result is an estimate.
---	Not applicable.

TABLE 2-2. CHEMICALS WITHOUT RBSLS AND ARARS OBSERVED IN THE SOIL, SEDIMENT, OR SURFACE WATER AT THE POINT LONELY INSTALLATION

SUBSTITUTED BENZENES
1,2,4-Trimethylbenzene
1,3,5-Trimethylbenzene
p-Isopropyltoluene
n-Butylbenzene
sec-Butylbenzene
ESSENTIAL HUMAN NUTRIENTS
Calcium
Iron
Magnesium
Potassium
Sodium
POLYNUCLEAR AROMATIC HYDROCARBONS
2-Methylnaphthalene

This section is a qualitative discussion of the potential for these chemicals to cause toxicity among the receptor groups identified at the Point Lonely installation. The essential human nutrients were discussed in Section 2.1.3 and will not be discussed further here. Essential nutrients are not considered COCs in this risk assessment.

The American Petroleum Institute (API) recently published an evaluation of the environmental fate, transport, and toxicity of 12 organic chemicals found frequently in petroleum products. The 12 were selected from a large list of candidates based on:

- abundance in crude and refined petroleum products, including residual and used oils;
- chemical/physical properties that represent a range of mobilities in soil and solubilities in aqueous environments; and
- toxicity in mammals and aquatic organisms (API 1994).

Two of the chemicals detected at the Point Lonely installation, 1,2,4-trimethylbeznene and naphthalene were selected from the list of twelve chemicals (API 1994) and are used in this risk

assessment as surrogates for the chemicals without RBSLs and ARARs. These chemicals have similar chemical structures and, therefore, will represent the substituted benzenes and the polynuclear aromatic hydrocarbons that do not have toxicity criteria (Table 2-2).

1,2,4-Trimethylbenzene has a low order of toxicity in mammals (API 1994). No effect was observed on the kidneys of rats that received 0.5 or 2.0 g/kg orally five days per week for four weeks. Inhalation of high concentrations of 1,2,4-trimethylbenzene produces central nervous system depression in humans and rats. Lung toxicity, including bronchitis, pneumonitis, and edema, was also observed in humans. 1,2,4-Trimethylbenzene has not been observed to be carcinogenic or mutagenic in laboratory studies of rats and cultured mammalian cells. Potential exposure of receptors to 1,2,4-trimethylbenzene at the Point Lonely installation would probably be limited to oral ingestion of soil and at the maximum concentration measured (7.82 mg/kg soil) would be expected to be nontoxic.[1] For the purposes of this risk assessment, 1,2,4-trimethylbenzene is considered to be a reasonable surrogate for the substituted benzenes observed at the Point Lonely installation.

Because of the lack of toxicology information available for 2-methylnaphthalene, naphthalene will be used as a surrogate in this discussion of chemicals without RBSLs and ARARs. Naphthalene has a low order of toxicity in mammals (API 1994). The toxicology of this chemical has been well characterized in several species, including humans, rats, rabbits, and mice. The toxicity in humans is known from cases of accidental or intentional (suicide) ingestion of contaminated food or mothballs, and the most common effect is liver damage (jaundice) and destruction of red blood cells resulting in anemia. These effects occur at exposure levels that far exceed the levels to which the receptor groups at the Point Lonely installation could be exposed. Dose-response information is available from studies in rats, mice, and rabbits. High doses of naphthalene administered over several days to one month resulted in cataract formation and other less serious ocular effects. High doses administered over several days to three months produced mild toxic effects on the liver, lung, kidney, and immunological system. The no effect level of oral exposure in these species occurs in the range of 100 to 300 mg naphthalene per kg body weight per day (100 to 300 mg/kg/day). The oral exposure levels to 2-methylnaphthalene that may occur through soil ingestion at the Point Lonely installation are approximately 0.0002 mg/kg/day. Furthermore, the maximum concentration of 2-methylnapthalene is less than the RBSL for naphthalene. Therefore, any exposure to 2-methylnaphthalene in the soil or surface water at the Point Lonely installation is expected to be nontoxic.[2]

In conclusion, the chemicals discussed above have been marked in Table 2-1 as potential COCs to indicate that there is some uncertainty in screening out these chemicals. Without toxicity criteria the potential risks of these chemical cannot be quantified. However, based on the

---

[1] Based on the following calculation: assume average daily soil ingestion rate of 200 mg of soil per day and 7.82 mg of 1,2,4-trimethylbenzene per kg of soil (maximum concentration measured at Point Lonely installation). This yields a dose of 0.00002 mg of 1,2,4-trimethylbenzene per kg body weight per day. The oral dose of 1,2,4-trimethylbenzene received by rats that showed no kidney effects was equivalent to 2,000 mg of 1,2,4-trimethylbenzene per kg body weight, which is more than 100,000,000 times greater than the estimated dose for potential receptors at the Point Lonely installation.

[2] Based on the following assumptions: soil ingestion rate, 200 mg/day; drinking water ingestion rate, 2 L/day; 70 kg body weight for typical receptor; maximum soil concentration of 2-methylnaphthalene, 6.82 mg/kg.

information presented above, and the concentrations measured at the sites, these chemicals are not expected to pose a heath risk.

Chemicals with RBSLs and/or ARARs. Following are discussions of the COCs at each site that exceeded background levels and an RBSL, ARAR, or both. Table 2-3 is a summary of the COCs selected for the sites at the Point Lonely installation.

2.1.5.1 Sewage Disposal Area (SS01).

Soil or Sediment. DRPH and GRPH were identified as COCs for the soil matrix at the Sewage Disposal Area (Table 2-1 and Figure 2-2). The maximum concentrations of DRPH and GRPH exceeded their background concentrations and the ARAR concentrations for petroleum hydrocarbon contamination of soil (ADEC 1991).

Surface Water. Benzene and chloromethane were identified as COCs for surface water at the Sewage Disposal Area (Table 2-1 and Figure 2-2). Benzene and chloromethane exceeded the background concentrations ($<1\,\mu g/L$, not detected) and their respective RBSLs based on cancer risk.

2.1.5.2 Drum Storage Area (ST02).

Soil or Sediment. DRPH and tetrachloroethene were identified as COCs for the soil matrix at the Drum Storage Area (Table 2-1 and Figure 2-3). DRPH exceeded its background concentration and the ARAR concentration for petroleum hydrocarbon contamination of soil (ADEC 1991). Tetrachloroethene exceeded its background and the RBSL based on cancer risk.

Surface Water. Benzene and toluene were identified as COCs for surface water at the Drum Storage Area (Table 2-1 and Figure 2-3). Benzene exceeded the background concentration ($<1\,\mu g/L$, not detected), the RBSL based on cancer risk, and the ARAR, which is an MCL promulgated under the federal Safe Drinking Water Act. Toluene exceeded its background concentration, the RBSL based on noncancer hazard, and the ARAR, which is an MCL promulgated under the federal Safe Drinking Water Act.

2.1.5.3 Beach Diesel Tanks (SS03).

Soil or Sediment. DRPH and GRPH were identified as COCs for the soil matrix at the Beach Diesel Tanks site (Table 2-1 and Figure 2-4). The maximum concentrations of DRPH and GRPH exceeded their background concentrations and the ARAR concentrations for petroleum hydrocarbon contamination of soil (ADEC 1991).

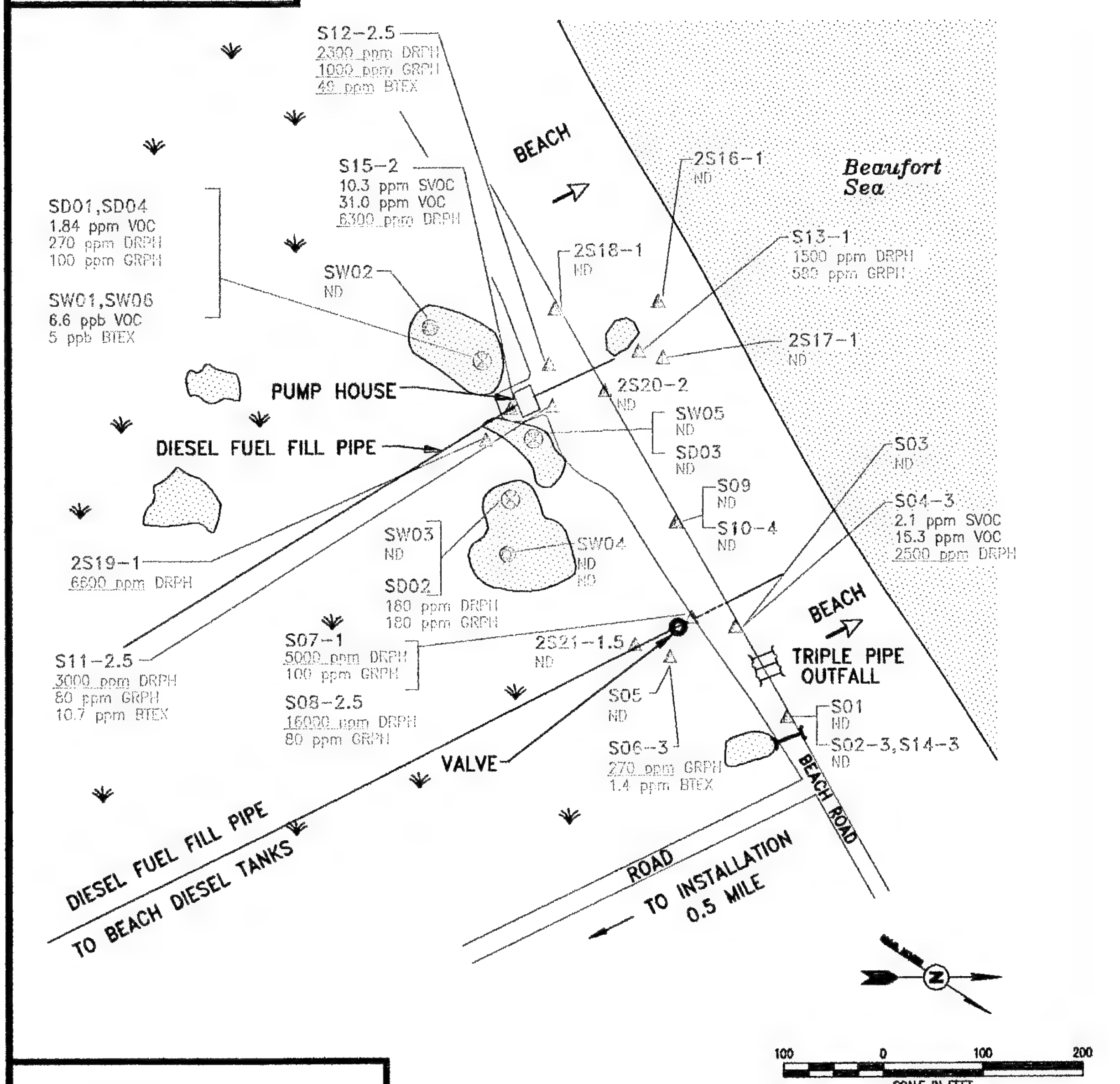
Surface Water. No COCs were identified for the surface water at the Beach Diesel Tanks site (Table 2-1 and Figure 2-4) because no chemicals were detected in surface water samples collected from this location.

TABLE 2-3. SUMMARY OF THE CHEMICALS OF CONCERN AT POINT LONELY

SITE	CHEMICALS OF CONCERN*	
	SOIL/SEDIMENT	SURFACE WATER
Sewage Disposal Area (SS01)	DRPH GRPH	Benzene Chloromethane
Drum Storage Area (ST02)	DRPH Tetrachloroethene	Benzene Toluene
Beach Diesel Tanks (SS03)	DRPH GRPH	NONE
POL Storage (SS04)	Benzene Trichloroethene Tetrachloroethene	GRPH Benzene cis-1,2-Dichloroethene Methylene chloride Tetrachloroethene Trichloroethene Toluene 4-Methylphenol Barium Manganese
Diesel Spills (SS05)	DRPH GRPH Benzene	GRPH Benzene
Old Dump Site (LF07)	RRPH	NONE
Garage (SS09)	DRPH GRPH RRPH Tetrachloroethene	Benzene Barium
Diesel Tank (ST10)	DRPH GRPH	NONE
Inactive Landfill (LF11) [Includes Vehicle Storage Area (SS14)]	NONE	GRPH Benzene Barium
Module Train (SS12)	NONE	NONE
Hangar Pad Area (SS13)	NONE	NONE

* The summary of COCs on this table includes only those chemicals detected that exceed background levels and an RBSL, ARAR, or both. COCs that exceed background levels but do not have an RBSL or ARAR are discussed in Section 2.1.5 (page 2-6).

DRAWING No. LONSS01



LEGEND

	BUILDINGS, STRUCTURES
	ROADS
	SOIL SAMPLE
	SURFACE WATER SAMPLE
	SEDIMENT AND WATER SAMPLES
	TUNDRA
	SURFACE WATER
	SURFACE DRAINAGE
	CULVERT
	GRAVEL PAD BOUNDARY
2.6 ppm	CT&E DATA
0.9 ppm	F&B DATA

0000	CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND	NO CONTAMINATION DETECTED
SVOC	TOTAL SEMI-VOLATILE ORGANIC COMPOUNDS
VOC	TOTAL VOLATILE ORGANIC COMPOUNDS
DRPH	DIESEL RANGE PETROLEUM HYDROCARBONS
GRPH	GASOLINE RANGE PETROLEUM HYDROCARBONS
BTEX	TOTAL BTEX COMPOUNDS

POINT LONELY RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 2-2

SEWAGE DISPOSAL AREA (SS01) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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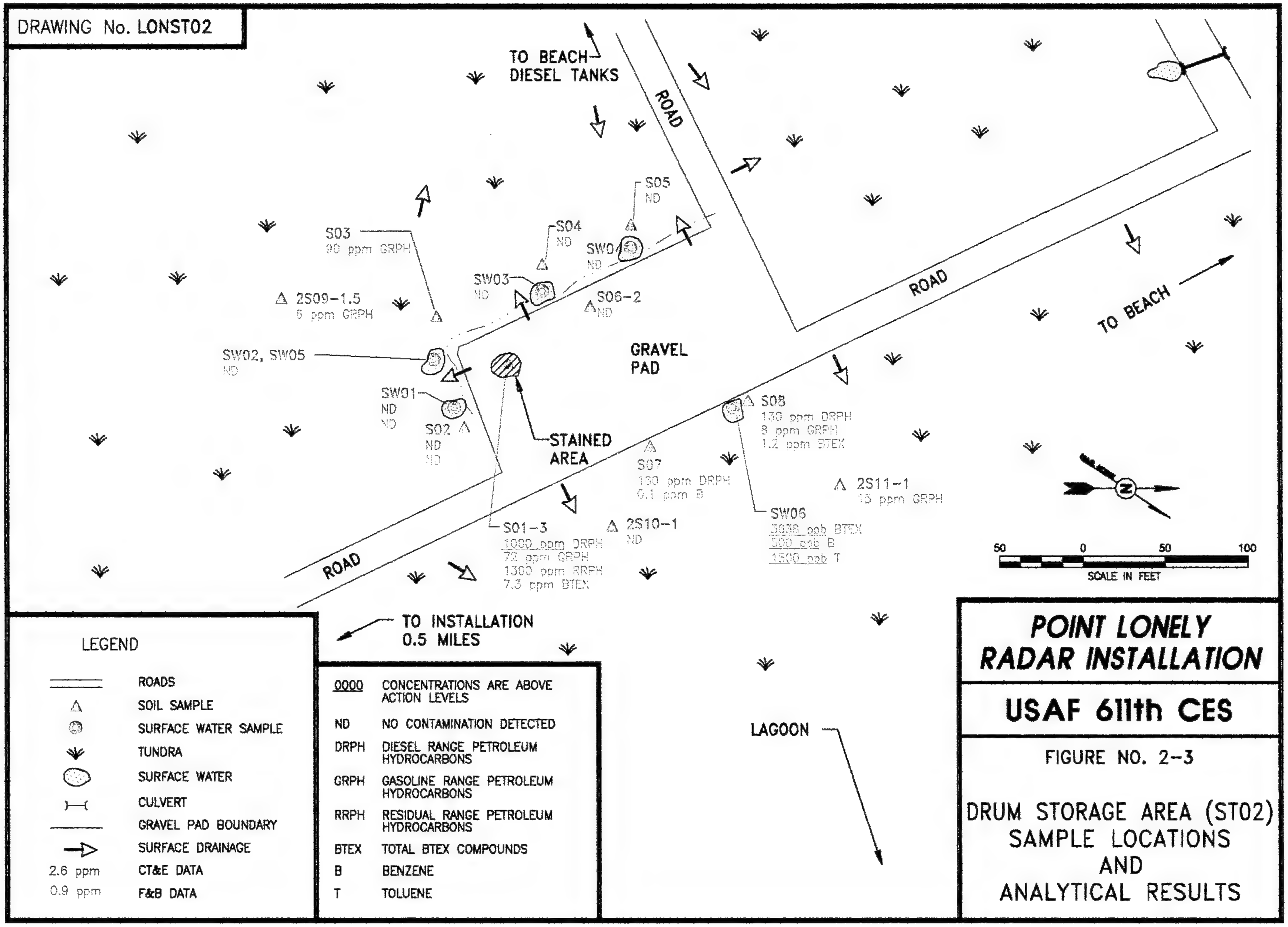
DRAWING No. LONST02
TO BEACH
DIESEL TANKS
ROAD
S05
ND
S04
ND
SW04
ND
S03
90 ppm GRPH
SW03
ND
S06-2
ND
2S09-1.5
5 ppm GRPH
GRAVEL
PAD
SW02, SW05
ND
SW01
ND
ND
S02
ND
ND
STAINED
AREA
S08
130 ppm DRPH
8 ppm GRPH
1.2 ppm BTEX
S07
130 ppm DRPH
0.1 ppm B
2S11-1
15 ppm GRPH
S01-3
1000 ppm DRPH
72 ppm GRPH
1300 ppm RRPH
7.3 ppm BTEX
2S10-1
ND
SW06
3838 ppb BTEX
300 ppb B
1500 ppb T
ROAD
TO BEACH
50
0
50
100
SCALE IN FEET
TO INSTALLATION
0.5 MILES
LAGOON
LEGEND
ROADS
SOIL SAMPLE
SURFACE WATER SAMPLE
TUNDRA
SURFACE WATER
CULVERT
GRAVEL PAD BOUNDARY
SURFACE DRAINAGE
2.6 ppm CT&E DATA
0.9 ppm F&B DATA
0000 CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND NO CONTAMINATION DETECTED
DRPH DIESEL RANGE PETROLEUM HYDROCARBONS
GRPH GASOLINE RANGE PETROLEUM HYDROCARBONS
RRPH RESIDUAL RANGE PETROLEUM HYDROCARBONS
BTEX TOTAL BTEX COMPOUNDS
B BENZENE
T TOLUENE
POINT LONELY
RADAR INSTALLATION
USAF 611th CES
FIGURE NO. 2-3
DRUM STORAGE AREA (ST02)
SAMPLE LOCATIONS
AND
ANALYTICAL RESULTS

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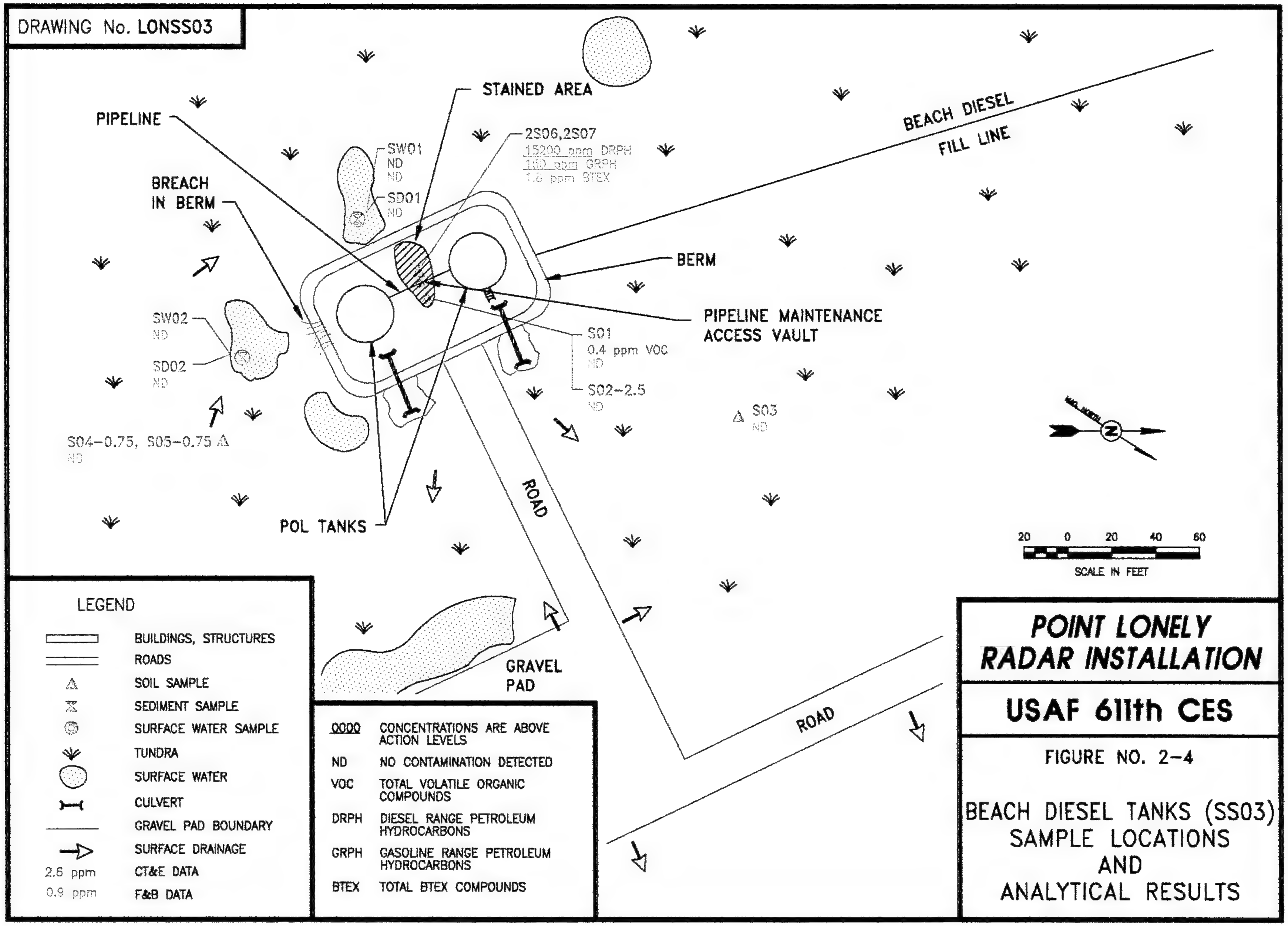

POINT LONELY RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 2-4

BEACH DIESEL TANKS (SS03) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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2.1.5.4 POL Storage (SS04).

Soil or Sediment. Benzene, trichloroethene, and tetrachloroethene were identified as COCs for the soil matrix at the POL Storage site (Table 2-1 and Figure 2-5). Benzene exceeded its background concentration and the ARAR which is a State of Alaska soil cleanup level for Non-UST contaminated soils (ADEC 1991). Trichloroethene exceeded the RBSL based on cancer risk. Tetrachloroethene exceeded its background and the RBSL based on cancer risk but not the RBSL based on noncancer hazard.

Surface Water. Several chemicals were identified as COCs for the surface water at the POL Storage site (Table 2-1 and Figure 2-5), including:

- GRPH - exceeds cancer and noncancer RBSLs,
- Benzene - exceeds cancer RBSL and MCL (ARAR),
- cis-1,2-Dichloroethene - exceeds noncancer RBSL and MCL (ARAR),
- Methylene chloride - exceeds cancer RBSL and MCL (ARAR),
- Tetrachloroethene - exceeds cancer and noncancer RBSLs and MCL (ARAR),
- Trichloroethene - exceeds MCL (ARAR),
- Toluene - exceeds noncancer RBSL and MCL (ARAR),
- 4-Methylphenol - exceeds noncancer RBSL,
- Barium - exceeds noncancer RBSL and MCL (ARAR), and
- Manganese - exceeds noncancer RBSL.

2.1.5.5 Diesel Spills (SS05).

Soil or Sediment. DRPH, GRPH, and benzene were identified as COCs for the soil matrix at the Diesel Spills site (Table 2-1 and Figure 2-6). The maximum concentrations of DRPH and GRPH exceeded their background concentrations and the ARAR concentrations for petroleum hydrocarbon contamination of soil (ADEC 1991). Benzene exceeded background and the ARAR, which is a State of Alaska soil cleanup level for Non-UST contaminated soils (ADEC 1991).

Surface Water. GRPH and benzene were identified as a COCs for the surface water at the Diesel Spills site (Table 2-1 and Figure 2-6). The maximum concentration of both chemicals exceeded background concentrations and the RBSL based on cancer risk. Benzene also exceeded the ARAR, which is an MCL promulgated under the federal Safe Drinking Water Act.

1,2-Dichloroethane was measured in one surface water sample at a concentration of 4.4 µg/L. 1,2-Dichloroethane was also observed in all the surface water background samples and several of the field blanks at the Point Lonely installation. These detections are assumed to be the result of field decontamination procedures. The hexane and methanol used in the decontamination procedures may have contained impurities including 1,2-dichloroethane. 1,2-Dichloroethane was less than five times the range of the concentrations detected in background surface water samples and field blanks; therefore, it is not considered a COC.

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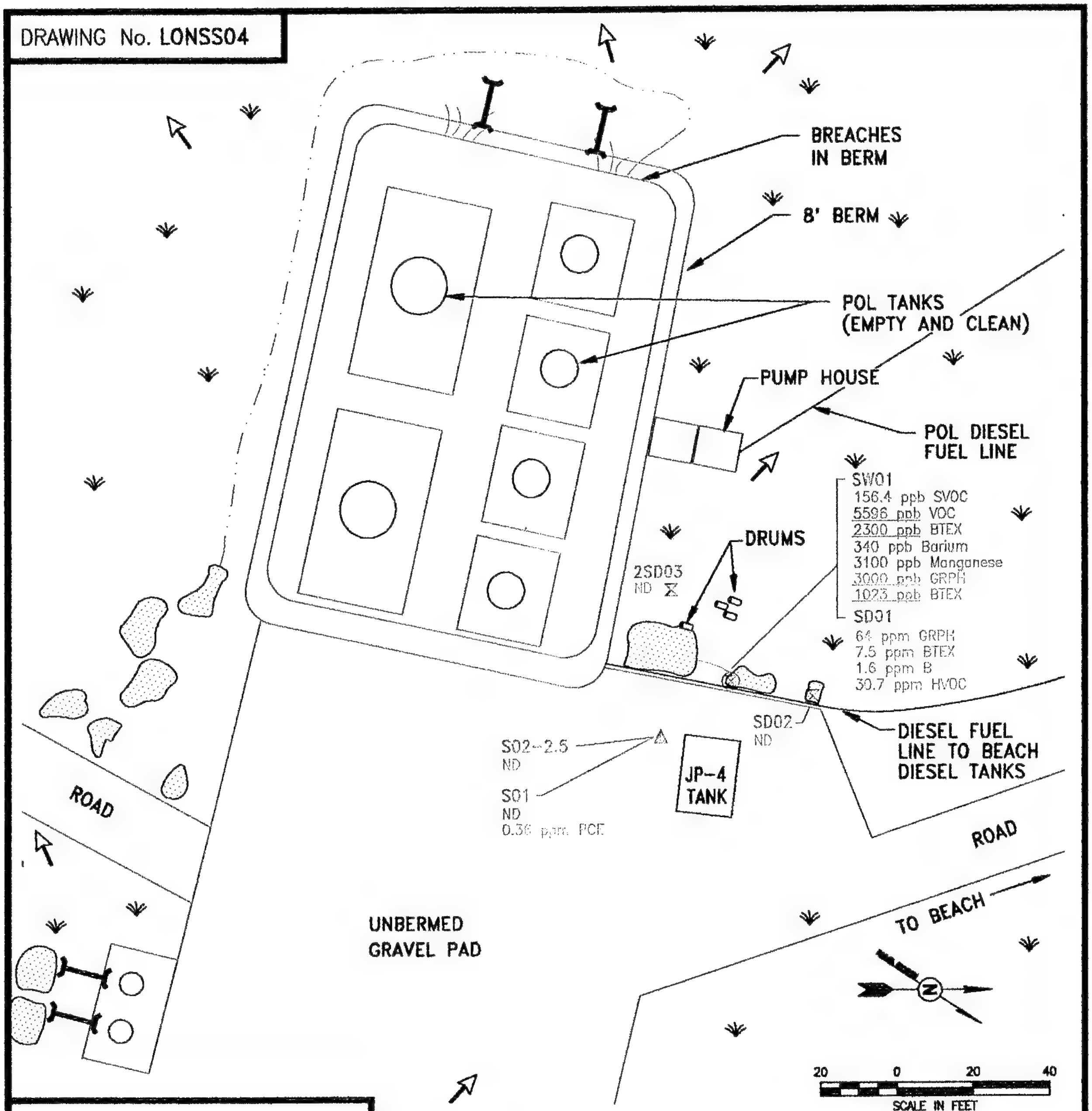
DRAWING No. LONSS04



LEGEND

	BUILDINGS, STRUCTURES
	ROADS, IMPROVED
	SOIL SAMPLE
	SEDIMENT SAMPLE
	SEDIMENT AND WATER SAMPLES
	TUNDRA
	SURFACE WATER
	CULVERT
	GRAVEL PAD BOUNDARY
	SURFACE DRAINAGE
2.6 ppm	CT&E DATA
0.9 ppm	F&B DATA

0000	CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND	NO CONTAMINATION DETECTED
SVOC	TOTAL SEMI-VOLATILE ORGANIC COMPOUNDS
VOC	TOTAL VOLATILE ORGANIC COMPOUNDS
DRPH	DIESEL RANGE PETROLEUM HYDROCARBONS
GRPH	GASOLINE RANGE PETROLEUM HYDROCARBONS
BTEX	TOTAL BTEX COMPOUNDS
B	BENZENE
HVOC	TOTAL HALOGENATED VOLATILE ORGANIC COMPOUNDS
PCE	TETRACHLOROETHENE

POINT LONELY RADAR INSTALLATION

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FIGURE NO. 2-5

POL STORAGE (SS04) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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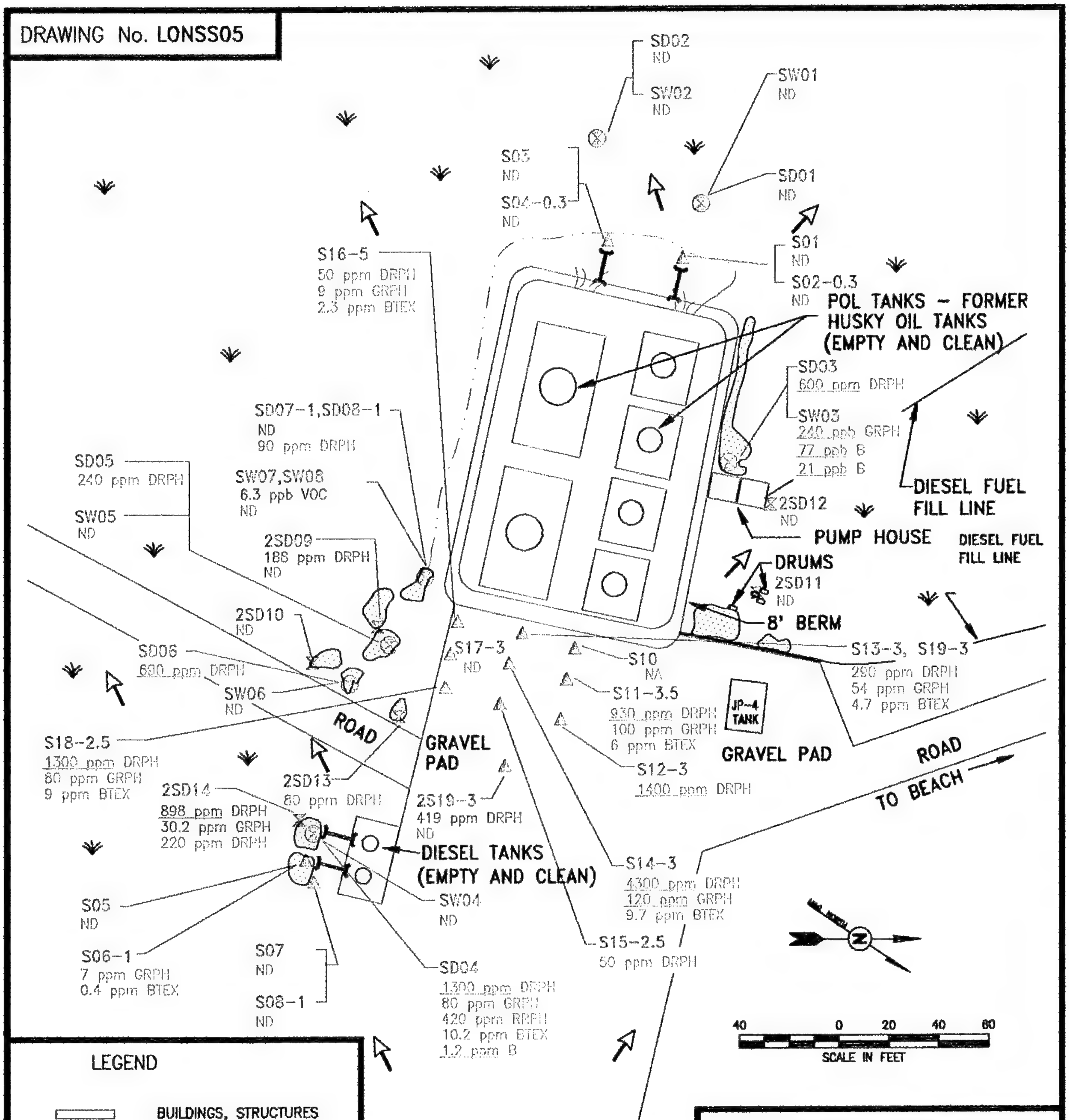

LEGEND

(symbol)	BUILDINGS, STRUCTURES
(symbol)	ROADS
△	SOIL SAMPLE
⧗	SEDIMENT SAMPLE
⊗	SEDIMENT AND WATER SAMPLES
(symbol)	TUNDRA
(symbol)	SURFACE WATER
(symbol)	CULVERT
(symbol)	GRAVEL PAD BOUNDARY
(symbol)	SURFACE DRAINAGE
2.6 ppm	CT&E DATA
0.9 ppm	F&B DATA

0000	CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND	NO CONTAMINATION DETECTED
VOC	TOTAL VOLATILE ORGANIC COMPOUNDS
DRPH	DIESEL RANGE PETROLEUM HYDROCARBONS
GRPH	GASOLINE RANGE PETROLEUM HYDROCARBONS
RRPH	RESIDUAL RANGE PETROLEUM HYDROCARBONS
BTEX	TOTAL BTEX COMPOUNDS
B	BENZENE

POINT LONELY RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 2-6

DIESEL SPILLS (SS05) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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2.1.5.6 Old Dump Site (LF07).

Soil or Sediment. RRPH were identified as a COC for the soil matrix at the Old Dump Site (Figure 2-7). RRPH exceeded the background concentration and the ARAR concentration for petroleum hydrocarbon contamination of soil (ADEC 1991) (Table 2-1).

Surface Water. No COCs were identified for the surface water at the Old Dump Site (Table 2-1 and Figure 2-7) based on a comparison of the maximum concentrations of detected chemicals to their background, RBSL, or ARAR concentrations.

2.1.5.7 Garage (SS09).

Soil or Sediment. DRPH, GRPH, RRPH, and tetrachloroethene were identified as COCs for the soil matrix at the Garage (Table 2-1 and Figure 2-8). The maximum concentrations of DRPH, GRPH, and RRPH exceeded the background concentration and the ARAR concentrations for petroleum hydrocarbon contamination of soil (ADEC 1991) (Table 2-1). The maximum concentration of tetrachloroethene exceeds the background concentration (not detected) and the RBSL based on cancer risk. Tetrachloroethene did not exceed the RBSL based on noncancer hazard.

Surface Water. Benzene and barium were identified as COCs for the surface water at the Garage (Table 2-1 and Figure 2-8). The maximum concentration of benzene exceeded the RBSL based on cancer risk but did not exceed the ARAR, which is an MCL promulgated under the federal Safe Drinking Water Act. The maximum concentration of barium exceeded the background concentration range of <50 to 93 μg/L and the RBSL based on noncancer hazard.

2.1.5.8 Diesel Tank (ST10).

Soil or Sediment. DRPH and GRPH were identified as COCs for the soil matrix at the Diesel Tank site (Table 2-1 and Figure 2-9). The maximum concentrations of DRPH and GRPH exceeded their background concentrations and the ARAR concentrations for petroleum hydrocarbon contamination of soil (ADEC 1991).

Surface Water. No COCs were identified for the surface water matrix at the Diesel Tank (ST10) site (Table 2-1 and Figure 2-9) based on a comparison of the maximum concentrations of detected chemicals to their background, RBSL, and ARAR concentrations. 1,2-Dichloroethane was measured in one surface water sample at a concentration of 2 μg/L. 1,2-Dichloroethane was also detected in all the surface water background samples and several of the field blanks at the Point Lonely installation. These detections are assumed to be the result of field decontamination procedures. The hexane and methanol used in the decontamination procedures may have contained impurities including 1,2-dichloroethane. 1,2-Dichloroethane was less than five times the range of the concentrations detected in background surface water samples and field blanks; therefore, it is not considered a COC

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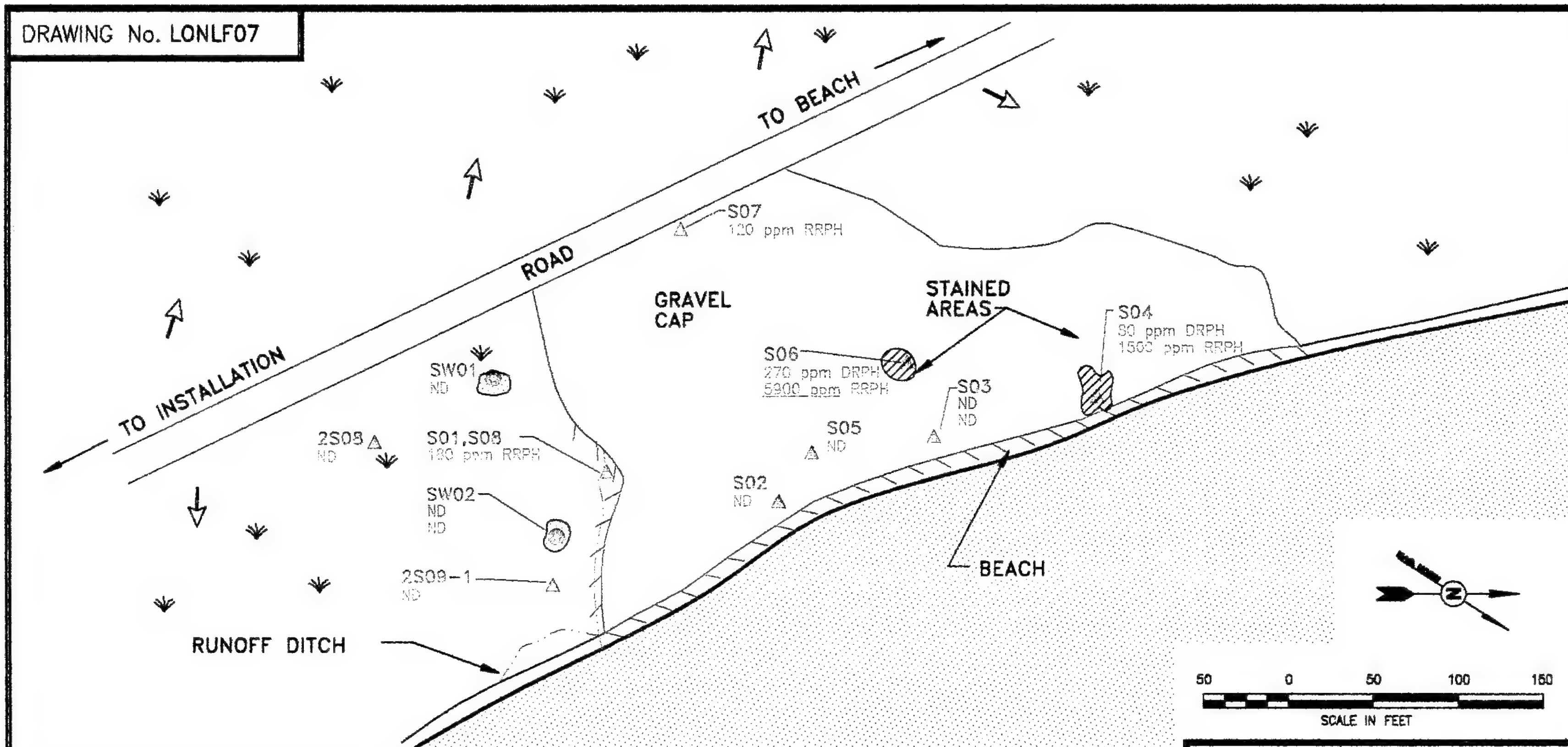

LEGEND

═	ROADS
△	SOIL SAMPLE
◎	SURFACE WATER SAMPLE
(symbol)	TUNDRA
◯	SURFACE WATER
—	GRAVEL PAD BOUNDARY
→	SURFACE DRAINAGE
2.5 ppm	CT&E DATA
0.9 ppm	F&B DATA
/////////	BLUFF

0000	CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND	NO CONTAMINATION DETECTED
DRPH	DIESEL RANGE PETROLEUM HYDROCARBONS
RRPH	RESIDUAL RANGE PETROLEUM HYDROCARBONS

POINT LONELY RADAR INSTALLATION

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FIGURE NO. 2-7

OLD DUMP SITE (LF07) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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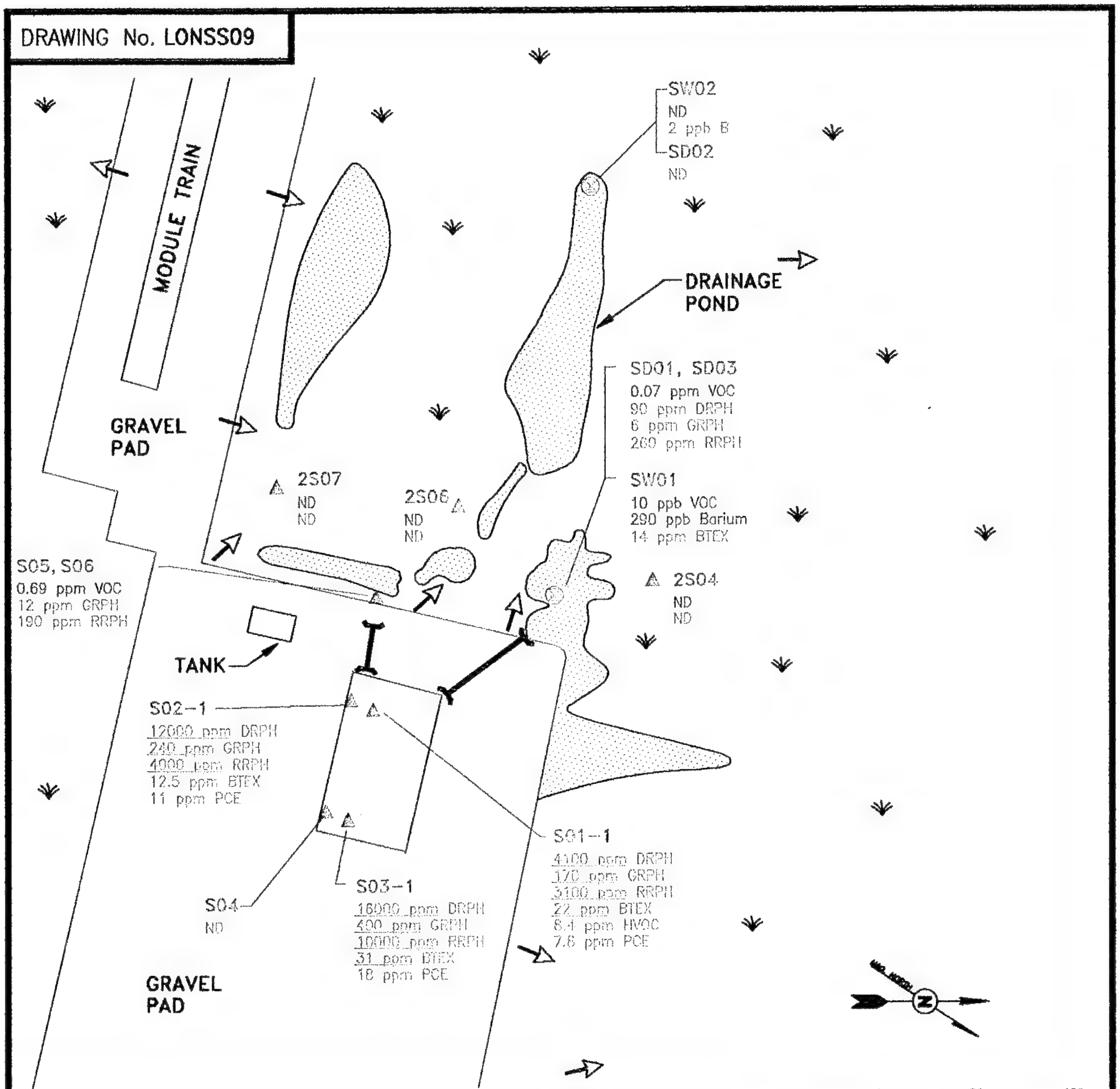

LEGEND

	BUILDINGS, STRUCTURES
	ROADS
	SOIL SAMPLE
	SEDIMENT AND WATER SAMPLES
	TUNDRA
	SURFACE WATER
	CULVERT
	GRAVEL PAD BOUNDARY
	SURFACE DRAINAGE
2.6 ppm	CT&E DATA
0.9 ppm	F&B DATA

0000	CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND	NO CONTAMINATION DETECTED
SVOC	TOTAL SEMI-VOLATILE ORGANIC COMPOUNDS
VOC	TOTAL VOLATILE ORGANIC COMPOUNDS
DRPH	DIESEL RANGE PETROLEUM HYDROCARBONS
GRPH	GASOLINE RANGE PETROLEUM HYDROCARBONS
RRPH	RESIDUAL RANGE PETROLEUM HYDROCARBONS
BTEX	TOTAL BTEX COMPOUNDS
HVOC	TOTAL HALOGENATED VOLATILE ORGANIC COMPOUNDS
B	BENZENE
PCE	TETRACHLOROETHENE

POINT LONELY RADAR INSTALLATION

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FIGURE NO. 2-8

GARAGE (SS09) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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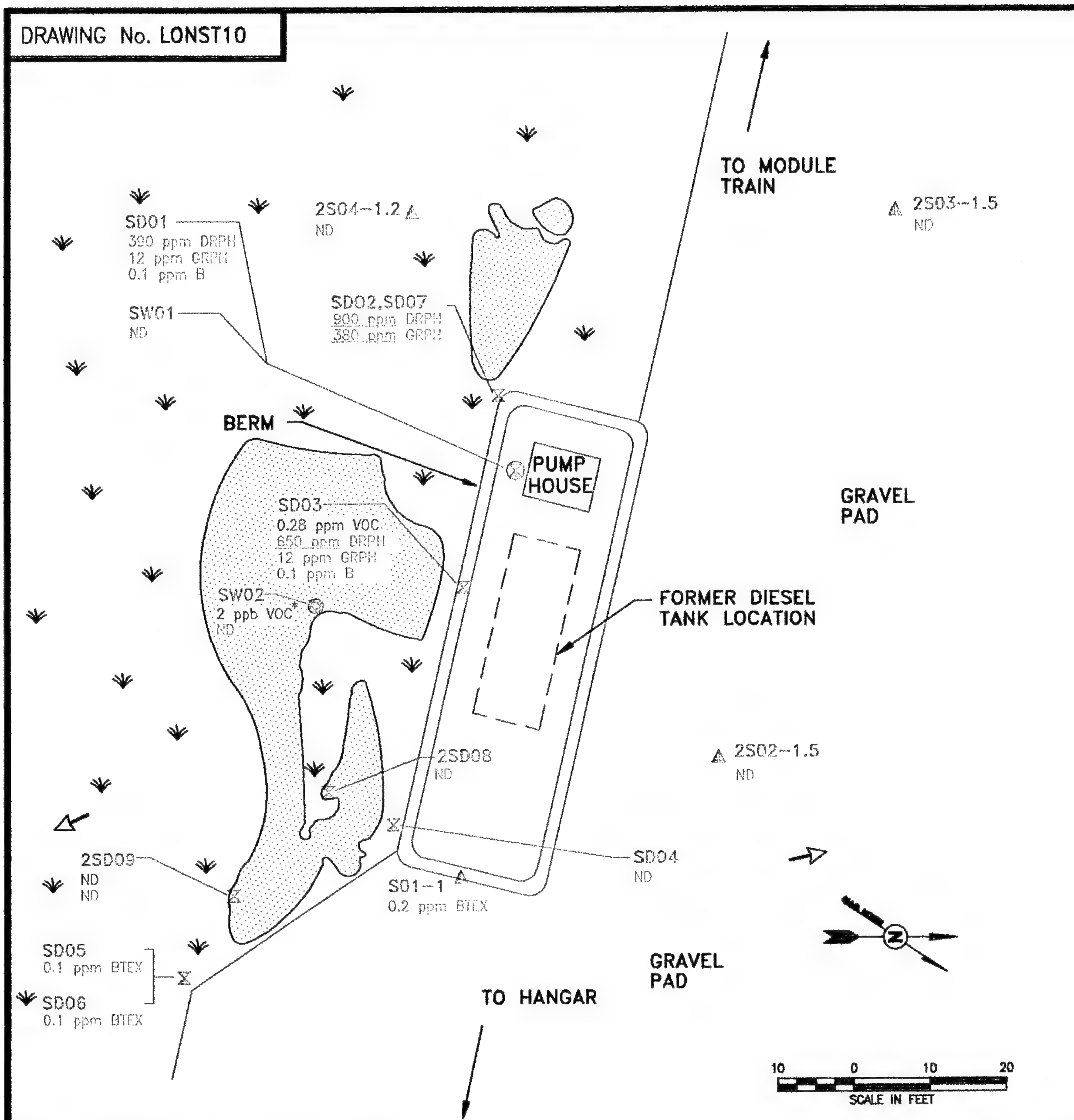

LEGEND

	BUILDINGS, STRUCTURES
	ROADS
	SOIL SAMPLE
	SEDIMENT SAMPLE
	SURFACE WATER SAMPLE
	SEDIMENT AND WATER SAMPLES
	TUNDRA
	SURFACE WATER
	GRAVEL PAD BOUNDARY
	SURFACE DRAINAGE
2.6 ppm	CT&E DATA
0.9 ppm	F&B DATA

0000	CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND	NO CONTAMINATION DETECTED
VOC	TOTAL VOLATILE ORGANIC COMPOUNDS
DRPH	DIESEL RANGE PETROLEUM HYDROCARBONS
GRPH	GASOLINE RANGE PETROLEUM HYDROCARBONS
BTEX	TOTAL BTEX COMPOUNDS
B	BENZENE

* COMMON LAB OR FIELD CONTAMINANT AND/OR DETECTED IN NUMEROUS BLANK SAMPLES.

POINT LONELY RADAR INSTALLATION

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FIGURE NO. 2-9

DIESEL TANK (ST10) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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2.1.5.9 Inactive Landfill (LF11)/Vehicle Storage Area (SS14).

Soil or Sediment. No COCs were identified for the soil matrix at the Inactive Landfill/Vehicle Storage Area (Table 2-1 and Figure 2-10) based on a comparison of the maximum concentrations of detected chemicals to their background, RBSL, and ARAR concentrations.

Surface Water. GRPH, benzene, and barium were identified as COCs for the surface water at the Inactive Landfill/Vehicle Storage Area (Table 2-1 and Figure 2-10). GRPH and benzene exceeded the RBSLs based on cancer risk. However, GRPH did not exceed the RBSL based on noncancer hazard, and benzene did not exceed the ARAR, which is an MCL promulgated under the federal Safe Drinking Water Act. Barium exceeded the RBSL based on noncancer hazard.

2.1.5.10 Module Train (SS12).

Soil or Sediment. No COCs were identified for the soil matrix at the Module Train (Table 2-1 and Figure 2-11) based on a comparison of the maximum concentrations of detected chemicals to their background, RBSL, and ARAR concentrations.

Surface Water. No COCs were identified for the surface water at the Module Train (Table 2-1 and Figure 2-11) based on a comparison of the maximum concentrations of detected chemicals to their background, RBSL, and ARAR concentrations.

2.1.5.11 Hangar Pad Area (SS13).

Soil or Sediment. No COCs were identified for the soil matrix at the Hangar Pad Area (Table 2-1 and Figure 2-12) based on a comparison of the maximum concentrations of detected chemicals to their background, RBSL, and ARAR concentrations.

Surface Water. No COCs were identified for the surface water at the Hangar Pad Area (Table 2-1 and Figure 2-12) based on a comparison of the maximum concentrations of detected chemicals to their background, RBSL, or ARAR concentrations.

2.1.5.12 Summary of Chemicals of Concern. The assessment of human health risk at the Point Lonely radar installation is based on the COCs identified in this section. A summary of the COCs is presented in Table 2-3.

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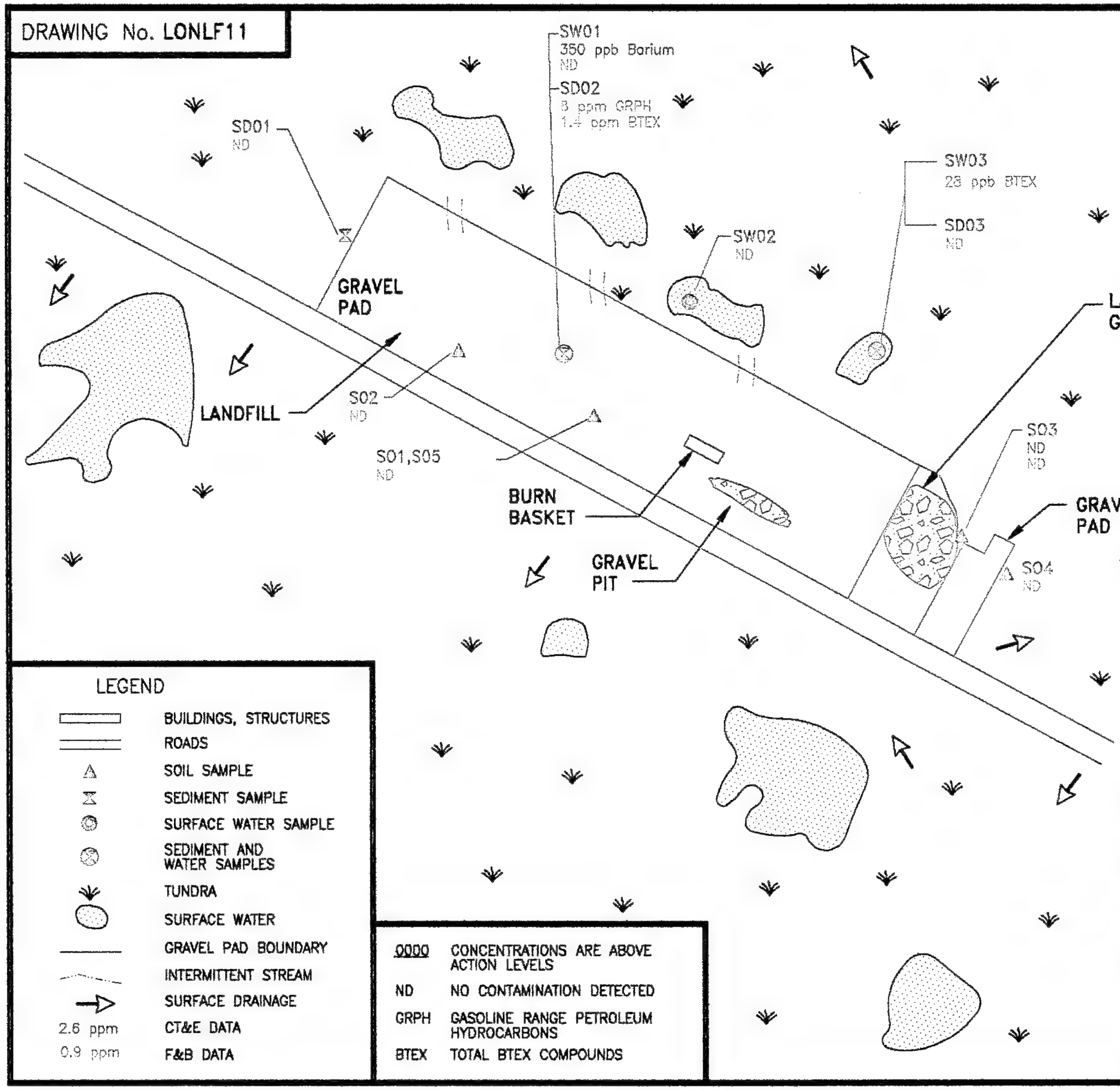

POINT LONELY RADAR INSTALLATION

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FIGURE NO. 2–10
INACTIVE LANDFILL (LF11)/
VEHICLE STORAGE AREA (SS14)
SAMPLE LOCATIONS
AND
ANALYTICAL RESULTS

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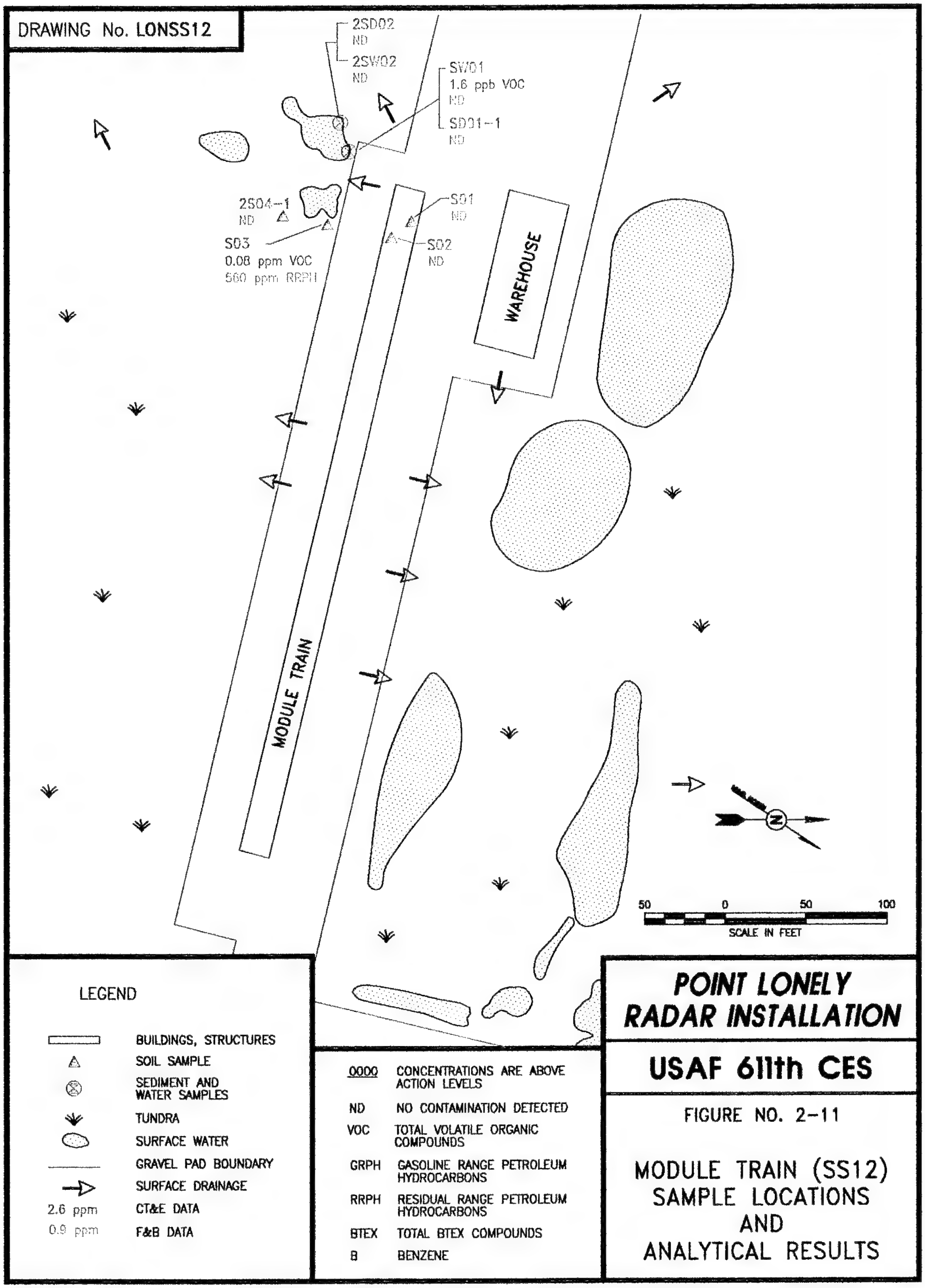

DRAWING No. LONSS12
2SD02
ND
2SW02
ND
SW01
1.6 ppb VOC
ND
SD01-1
ND
2S04-1
ND
S01
ND
S03
0.08 ppm VOC
560 ppm RRPH
S02
ND
WAREHOUSE
MODULE TRAIN
50
0
50
100
SCALE IN FEET
LEGEND
BUILDINGS, STRUCTURES
SOIL SAMPLE
SEDIMENT AND WATER SAMPLES
TUNDRA
SURFACE WATER
GRAVEL PAD BOUNDARY
SURFACE DRAINAGE
2.6 ppm CT&E DATA
0.9 ppm F&B DATA
0000 CONCENTRATIONS ARE ABOVE ACTION LEVELS
ND NO CONTAMINATION DETECTED
VOC TOTAL VOLATILE ORGANIC COMPOUNDS
GRPH GASOLINE RANGE PETROLEUM HYDROCARBONS
RRPH RESIDUAL RANGE PETROLEUM HYDROCARBONS
BTEX TOTAL BTEX COMPOUNDS
B BENZENE
POINT LONELY RADAR INSTALLATION
USAF 611th CES
FIGURE NO. 2-11
MODULE TRAIN (SS12) SAMPLE LOCATIONS AND ANALYTICAL RESULTS

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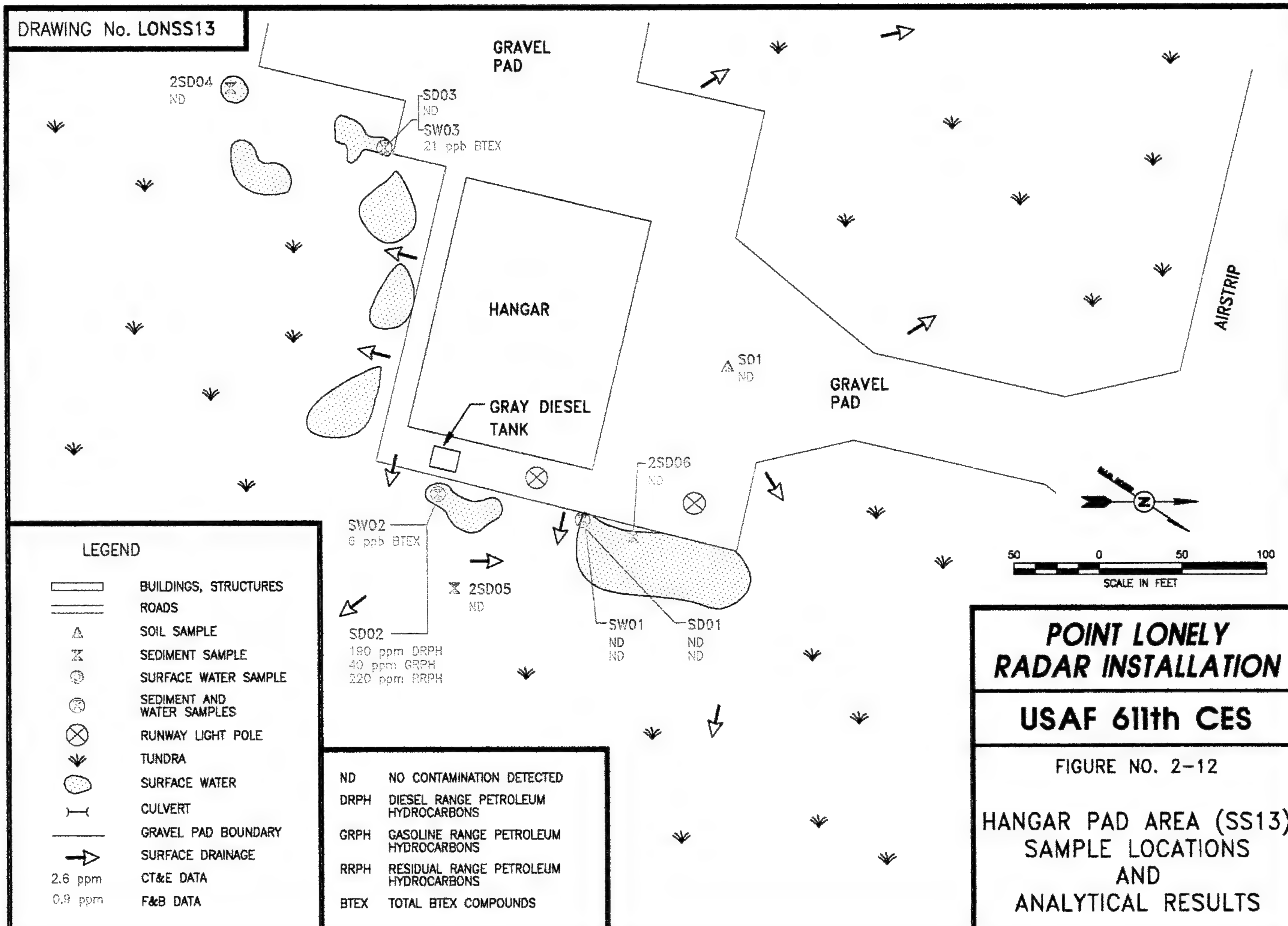

ND	NO CONTAMINATION DETECTED
DRPH	DIESEL RANGE PETROLEUM HYDROCARBONS
GRPH	GASOLINE RANGE PETROLEUM HYDROCARBONS
RRPH	RESIDUAL RANGE PETROLEUM HYDROCARBONS
BTEX	TOTAL BTEX COMPOUNDS

POINT LONELY RADAR INSTALLATION

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FIGURE NO. 2-12

HANGAR PAD AREA (SS13)
SAMPLE LOCATIONS
AND
ANALYTICAL RESULTS

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2.2 EXPOSURE ASSESSMENT

The exposure assessment section of a baseline human health risk assessment identifies and describes potential receptors and the exposure pathways by which exposure may occur, and estimates the magnitude of those exposures. This section includes an analysis of which pathways are complete (Section 2.2.1), migration and fate of COCs (Section 2.2.2), an estimation of the total intake of the chemicals (Section 2.2.3), and a summary of how the average daily dose (ADD) was calculated (Section 2.2.4).

2.2.1 Pathway Analysis

Pathway analysis involves the evaluation of the components of potential exposure pathways and a determination of whether each pathway is complete. An exposure pathway describes the course a chemical will take from a source to an exposure point where a receptor can come into contact with the chemical. A complete exposure pathway has five components:

- source of contamination;
- release mechanism;
- transport mechanism;
- exposure point; and
- receptor.

If one component of an exposure pathway does not exist, then exposure will not occur and there is no health risk. For example, if a shallow aquifer was contaminated with tetrachloroethene, but that aquifer was not used as a water supply, no exposure point would exist and a ground water ingestion pathway would not be complete.

The potential exposure pathways evaluated for the Point Lonely human health risk assessment are presented in Figure 2-13 and Table 2-3, and are discussed in Sections 2.2.1.1 through 2.2.1.4.

2.2.1.1 Soil and Sediment Ingestion. DEW Line installation workers and residents of the North Slope Borough may be exposed to soil and sediment contaminated by previous operations at the installation. The most likely exposure routes are incidental ingestion of soil and dermal absorption of contaminants in the soil. Site-specific characteristics will limit the magnitude, frequency, and duration of exposures to soil and sediment. The ground is covered with snow and ice, eliminating soil or sediment exposure, for approximately nine months of the year. In the summer months when snow cover is generally absent, cool temperatures (29°F to 44°F) (University of Alaska 1978) keep both workers and native residents in heavy, long-sleeved clothing and gloves that eliminate dermal contact with and hand-to-mouth transfer of soil. Therefore, although both the incidental soil ingestion and dermal contact pathways are unlikely to be complete, the incidental ingestion of soil or sediment will be evaluated further in this risk assessment in order to provide conservative estimates of risk.

The exposure assumptions used to evaluate the soil and sediment ingestion pathway are upper bound residential scenario assumptions and, therefore, probably overestimate the true hazard

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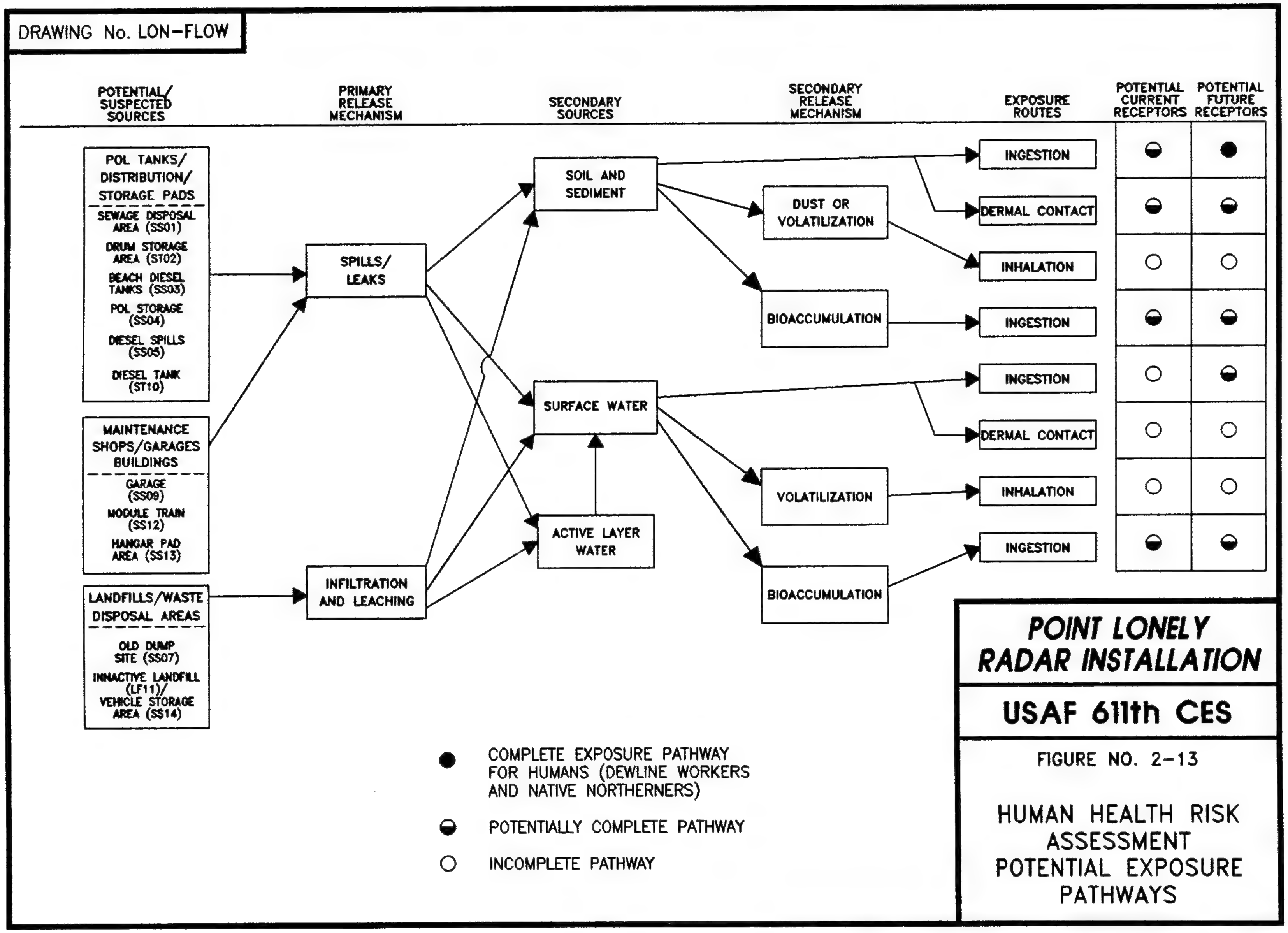
DRAWING No. LON-FLOW
POTENTIAL/ SUSPECTED SOURCES
PRIMARY RELEASE MECHANISM
SECONDARY SOURCES
SECONDARY RELEASE MECHANISM
EXPOSURE ROUTES
POTENTIAL CURRENT RECEPTORS
POTENTIAL FUTURE RECEPTORS
POL TANKS/ DISTRIBUTION/ STORAGE PADS
SEWAGE DISPOSAL AREA (SS01)
DRUM STORAGE AREA (ST02)
BEACH DIESEL TANKS (SS03)
POL STORAGE (SS04)
DIESEL SPILLS (SS05)
DIESEL TANK (ST10)
MAINTENANCE SHOPS/GARAGES BUILDINGS
GARAGE (SS09)
MODULE TRAIN (SS12)
HANGAR PAD AREA (SS13)
LANDFILLS/WASTE DISPOSAL AREAS
OLD DUMP SITE (SS07)
INNACTIVE LANDFILL (LF11)/ VEHICLE STORAGE AREA (SS14)
SPILLS/ LEAKS
INFILTRATION AND LEACHING
SOIL AND SEDIMENT
SURFACE WATER
ACTIVE LAYER WATER
DUST OR VOLATILIZATION
BIOACCUMULATION
VOLATILIZATION
BIOACCUMULATION
INGESTION
DERMAL CONTACT
INHALATION
INGESTION
INGESTION
DERMAL CONTACT
INHALATION
INGESTION
COMPLETE EXPOSURE PATHWAY FOR HUMANS (DEWLINE WORKERS AND NATIVE NORTHERNERS)
POTENTIALLY COMPLETE PATHWAY
INCOMPLETE PATHWAY
POINT LONELY RADAR INSTALLATION
USAF 611th CES
FIGURE NO. 2-13
HUMAN HEALTH RISK ASSESSMENT POTENTIAL EXPOSURE PATHWAYS

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TABLE 2-4. EXPOSURE PATHWAY ANALYSIS FOR POINT LONELY HUMAN HEALTH RISK ASSESSMENT

POTENTIALLY CONTAMINATED MEDIUM	POTENTIAL ROUTES OF EXPOSURE	POTENTIAL RECEPTORS	PATHWAY COMPLETE?	EXPOSED POPULATION ESTIMATE
Soil	Ingestion, dermal absorption	DEW Line workers, North Slope residents	Ingestion, Yes Dermal Contact, No	100[a]
Sediments	Ingestion, dermal absorption	DEW Line workers, North Slope residents	Ingestion, Yes Dermal Contact, No	100[a]
Air	Inhalation of volatiles from soil or surface water or inhalation of fugitive dust	DEW Line workers, North Slope residents	No, volatile concentrations in soil and surface water are very low; dust generation is not likely because of marshy vegetated landscape and high humidity; and snow and ice cover most of the year.	0
Surface Water	Incidental ingestion, dermal absorption	DEW Line workers, North Slope residents	Maybe, drinking water supplies are either upgradient from installation or in unaffected areas. Fishing occurs in unaffected areas. Swimming does not occur onsite; however, incidental exposure may occur during installation operations or trespassing by native villagers.	100[a]
Ground Water	Ingestion, dermal absorption	DEW Line workers, North Slope residents	No, permafrost limits presence of ground water to shallow active layer that is not used for any purpose.	0

[a] Assumes future residential land use. Currently, this installation is unmanned and there is no nearby village. The exposed population is an estimate of the size of a village that might exist at Point Lonely if the installation was ever released for residential use.

or risk associated with this pathway. The purpose of using residential assumptions is to evaluate the hazard or risk associated with future residential use of the Point Lonely installation. It is possible that the installation may be retired and released for civilian use, in which case residential use of the installation may be possible.

2.2.1.2 Inhalation. DEW Line installation workers and residents of the North Slope Borough may be exposed to site contamination by inhalation of organic compounds that have volatilized from the soil or surface water, or by inhalation of windborne dust to which contamination has adsorbed. These exposure pathways are not considered complete for the Point Lonely risk assessment because snow and ice cover the site for approximately nine months of the year, and during the summer months the high humidity, vegetative cover, and thawing of surface and active layer water significantly limit the entrainment of dust particles in ambient air.

The generally low temperatures and high moisture content of the soil also tend to inhibit volatilization. The inhalation pathway will not be considered further in this risk assessment.

2.2.1.3 Water Ingestion. Surface water features, particularly those potentially contaminated by operations at the installation, are not likely to be used for drinking or other domestic purposes even on an incidental basis. This is because these surface water features are frozen for most of the year. Therefore, they are not reliable sources of water for domestic or industrial use. Ingestion of surface water will, however, be considered a potentially complete exposure pathway to reflect an upper bound potential future risk under a future use scenario. Under current conditions, the installation is unmanned and surface water is not used for domestic or other purposes. Water for the installation was previously obtained from a freshwater lake less than one mile south.

2.2.1.4 Ground Water. Permafrost limits the presence of ground water to the active layer, which thaws during the summer months. The water present in the active layer is not known to be used for any purpose; therefore, a ground water pathway will be eliminated from consideration in this risk assessment.

2.2.2 Migration and Fate of Chemicals of Concern

The COCs selected for Point Lonely generally fall into four classes:

- refined and residual petroleum hydrocarbons (DRPH, GRPH, and RRPH);
- volatile organic compounds (VOCs: benzene, chloromethane, cis-1,2-dichloroethene, methylene chloride, tetrachloroethene, trichloroethene, and toluene);
- semi-volatile organic compounds (SVOCs: 4-methylphenol); and
- metals (barium and manganese).

This section presents a summary of the migration and fate of each of these classes give the environmental conditions at Point Lonely.

Once released to the environment, the COCs are immediately subject to several processes, including evaporation and volatilization, bulk flow, soil adsorption, dissolution in surface or active layer water, biodegradation, and photooxidation. The extent to which the COCs undergo each of these processes depends on their chemical and physical properties (e.g., K_{oc}, K_{ow}, water solubility, vapor pressure, Henry's law constant), the volume released, soil flora, meteorological conditions, soil moisture, and organic carbon content.

The migration of petroleum hydrocarbons released to the gravel pads and tundra is expected to follow the rank order: GRPH > DRPH > RRPH. GRPH is generally considered to include hydrocarbons with carbon chain ranges from C5 to C12 that tend to be relatively mobile and less persistent than longer chain hydrocarbons. Depending on the length of time since a spill or leak occurred, the petroleum hydrocarbons observed in soil samples would be expected to be enriched in components that have carbon chain ranges greater than C10 or C11, have high K_{oc} and K_{ow} values, low vapor pressure and water solubility, and are not rapidly biodegradable. Petroleum components that fit this profile are higher molecular weight n-alkanes, mono- and poly-aromatics, and cycloalkanes. These components would tend to appear in laboratory analyses as diesel range or heavy oil range organics (DRPH and RRPH).

The migration of VOCs is expected to be rapid compared to the petroleum hydrocarbons. VOCs tend to have high vapor pressures which favor volatilization, high water solubility, and low K_{oc} and K_{ow} values. Therefore, VOCs would tend to be highly mobile in the environment and dissipate rapidly after a spill or leak. In the results of field sampling, VOC concentrations would be expected to be fairly low depending on the time since the spill or leak occurred. The frigid conditions on the North Slope, however, would tend to reduce the mobility due to volatilization or evaporation.

The metals observed at Point Lonely are probably of natural origin and not due to the operation of or activities at the radar installation. The presence of manganese in water samples is most often associated with leachate from contaminated areas since the anaerobic and acidic conditions tend to release naturally occurring manganese from the soil. Metals will tend to be persistent and of low mobility in the environment.

In conclusion, the COCs observed at the Point Lonely installation are generally expected to be fairly persistent and of low mobility. Exposure by contact with soils, primarily through accidental ingestion, is expected to predominate compared to exposure by inhalation.

2.2.3 Estimation of Chemical Intake

The exposure assessment for the Point Lonely DEW Line installation required the development of site-specific assumptions because of the unique location on the North Slope of Alaska and unmanned operation of the installation. This section of the report focuses on the exposure variables for which site-specific assumptions were made. These variables include:

- exposure frequency;
- exposure duration;
- ingestion of locally produced meat (e.g., caribou, fish, and birds);
- ingestion of locally produced vegetation (e.g., berries);
- soil ingestion rate; and
- rate of dermal contact with soil.

The exposure assumptions used in the human health risk assessment are presented in Table 2-5.

Three potential receptor groups will be evaluated for the Point Lonely risk assessments: an adult assigned to maintenance work at the Point Lonely installation (DEW Line worker), an adult native of the North Slope of Alaska (native), and a native child (child). The native adult and child are considered to represent the reasonable maximum exposure that might occur at the installation under a future use scenario that includes residential receptors. Although there are no plans to do so, the Point Lonely installation may be released for civilian residential use in the future.

The estimation of chemical intake requires the evaluation of several exposure variables: exposure point concentration; exposure frequency; exposure duration; averaging time; ingestion of locally produced meat, fish, and vegetation; soil ingestion; drinking water ingestion; dermal contact with soil; inhalation; and body weight. These exposure variables are discussed in the following sections.

TABLE 2-5. EXPOSURE ASSUMPTIONS FOR ESTIMATING CHEMICAL INTAKE

PARAMETER	DEW LINE WORKER	NATIVE NORTHERN ADULT	NATIVE NORTHERN CHILD
Exposure Frequency - Soil Ingestion (days/year)	14	30	30
Exposure Frequency - Water Ingestion (days/year)	14	180	N/A
Exposure Duration (years)	10	55[a]	6[a]
Soil Ingestion Rate (mg/day)	50	100	200
Drinking Water Ingestion Rate (L/day)	2	2	N/A
Average Body Weight (kg)	70	70	15
Averaging Time (days)	25,550 (cancer)[b] 3,650 (noncancer)[c,d]	25,550 (cancer)[b] 20,075 (noncancer)[c] 17,885 (noncancer)[d]	2,190 (noncancer)[d]

N/A Not applicable; drinking water pathway evaluated for adult only.

a Exposure duration for water ingestion pathway is 55 years. For soil ingestion, exposure duration is 6 years as a child and 49 years as an adult.

b Averaging time for the evaluation of cancer risk by the soil and water ingestion pathways.

c Averaging time for the evaluation of noncancer hazard by the water ingestion pathway.

d Averaging time for the evaluation of noncancer hazard by the soil ingestion pathway.

2.2.3.1 Exposure Point Concentration. Based on the amount of analytical data available for the risk assessment of the Point Lonely installation, and the requirement that the risk characterization be conducted individually for each of the 11 sites, only maximum concentrations of the COCs were used for exposure point concentrations. This approach yields a conservative upper-bound estimate of the average daily dose (ADD) for potential receptors.

2.2.3.2 Exposure Frequency. The exposure frequency variable is an estimate of the amount of time a potential receptor may contact contaminated media. For the DEW Line worker, the exposure frequency estimate is based on the assumption that the radar installation will require two maintenance visits per year, with each visit lasting fourteen days. Based on the assumption that the maintenance visits will require 12-hour workdays, an estimated exposure frequency for DEW Line workers at the unmanned installation would be 12 hour/day x 1 day/24 hours x 28 days/years = 14 days/year.

The soil ingestion exposure frequency estimate for a native adult or child of the North Slope is based on an estimate of the frequency with which the individual would be at a DEW Line installation involved in activities that include exposure to soil. Such visits are likely to occur at installations sited near a village or city. Point Lonely is not located near a village or city; however, a future residential scenario is possible. In this case, a conservative estimate of exposure would be 4 hrs/day x 30 days per month x 1 day/24 hrs x 6 months of exposed soil per year = 30 days per year.

The exposure frequency for water ingestion was conservatively estimated at 180 days/year that surface water would be available (i.e., not frozen), and is based on a potential future scenario where site surface water is used as a drinking water source.

2.2.3.3 Exposure Duration. The exposure duration variable is an estimate of the amount of time a potential receptor will remain at or near a DEW Line installation over a lifetime. For the DEW Line worker the exposure duration is an estimate of the maximum tour of duty at an installation. A conservative estimate of the duration of a tour at a particular installation is 10 years. For the potential native receptor, a conservative estimate of exposure duration is 55 years based on the assumption that the site use will be residential. EPA's default reasonable maximum exposure duration is 30 years; however, this is based on the overall U.S. population. Because the Alaskan natives are more likely to remain in their village for a longer period, 55 years was determined to be a more appropriate estimate based on best professional judgement.

2.2.3.4 Averaging Time. The averaging time represents the period of time over which exposure is averaged and is based on the assumption that intermittent exposure at a given contaminant concentration is equivalent to a continuous exposure at a lower concentration. For the DEW Line worker, the averaging time is based on the EPA default lifetime of 70 years for evaluation of carcinogens, and 10 years (equivalent to the exposure duration) for the evaluation of noncarcinogens. For the native northern adult an averaging time of 70 years for carcinogens was also chosen. To evaluate exposure to noncarcinogens in soil and sediment for the native northern adult and child, an averaging time of 49 years as an adult and 6 years as a child was used (to account for 55 year total exposure). To evaluate the exposure of native northern receptors to noncarcinogens in water an averaging time of 55 years was used.

2.2.3.5 Ingestion of Locally Produced Meat, Fish, and Vegetation. The food supplies of DEW Line installation workers are largely imported from outside the area. Occasionally, a worker would be expected to ingest a locally caught fish or game animal, but the frequency and magnitude of this ingestion is expected to have a negligible effect on exposure to the COCs. Food supplies for the residents of the North Slope Borough are partly imported from outside the area, and some reports indicate that the reliance on hunting and fishing for subsistence is decreasing as the economy moves from subsistence to wage labor (Chance 1990). Although Inupiats in general have less time to hunt and fish than in the past, up to 50 percent of their food may derive from subsistence activities (Harcharek 1994). Most of the hunting and fishing occurs away from the Point Lonely DEW Line installation in areas unaffected by the installation. It is unlikely that contamination observed at the installation has affected the mammals, birds, and vegetation that may be collected for consumption. Therefore, the consumption of locally produced food is not likely to pose a significant risk of adverse health effects and will not be considered a complete exposure pathway. The ERA, Section 3.0, presents a detailed assessment of risks to ecological receptors.

2.2.3.6 Soil Ingestion Rate. A conservative approach to estimating soil ingestion rate is to assume that the EPA default soil ingestion rate of 50 mg/kg for workers (EPA 1991a) and 100 mg/day for adults in a residential setting is applicable to the Point Lonely installation. The EPA default soil ingestion rate for children is 200 mg/day; this is the recommended value for the risk assessment.

2.2.3.7 Drinking Water Ingestion Rate. There are no circumstances at the Point Lonely installation that would invalidate the EPA default adult drinking water ingestion rate of 2 L/day. Therefore, this is the recommended value for both workers and residents of the North Slope Borough. However in most, if not all, cases drinking water (when the installation was manned) was imported from offsite so this may not be a complete route of exposure.

By convention (EPA 1989a), noncancer hazard and cancer risk associated with the drinking water pathway are evaluated for an adult receptor, not a child (Table 2-5). The basis for this approach is that the ratio of drinking water ingestion rate to body weight is assumed to be relatively constant from childhood to adulthood.

2.2.3.8 Dermal Contact with Soil Rate. Because of the harsh North Slope weather, potential receptors (both workers and residents of the North Slope Borough) are expected to be heavily clothed and gloved. Observations made by RI field personnel indicate that potential human receptors were heavily clothed during the months of the field investigations (August and September 1993). Therefore, dermal exposure to contaminated soils is considered negligible. In addition, the duties of installation workers that involve soil work (excavating, grading, etc.) are conducted in equipment with enclosed cabs. Thus, a dermal contact rate does not appear to be necessary for the exposure assessment.

2.2.3.9 Inhalation Rate. The inhalation pathway is not complete (Section 2.2.1.2), so no estimate for this variable is necessary.

2.2.3.10 Body Weight. There are no circumstances at the Point Lonely installation that would invalidate the EPA default adult body weight of 70 kg. Therefore, this is the recommended value for both workers and residents of the North Slope Borough. The recommended body weight for children is the EPA default value of 15 kg.

2.2.4 Quantifying Exposure

For each complete, or potentially complete, exposure pathway at the Point Lonely installation (soils and drinking water ingestion), the ADD for estimating noncancer hazard, and the lifetime average daily dose (LADD) for estimating excess lifetime cancer risk were calculated. The equations used for the calculation of ADD and LADD are presented in Table 2-6.

The exposure assumptions assigned to each variable in these equations are presented in Table 2-5. The estimates of ADD and LADD for the COCs at each site are presented in the risk characterization spreadsheets in Appendix A.

2.3 TOXICITY ASSESSMENT

The purpose of the toxicity assessment is to weigh available evidence regarding the potential for particular contaminants to cause adverse effects in exposed individuals and to provide, where possible, an estimate of the relationship between the extent of exposure to a contaminant and the increased likelihood or severity of adverse effects or both. This is done separately for noncarcinogenic effects (Section 2.3.1) and carcinogenic effects (Section 2.3.2). Toxicity summaries are presented in Section 2.3.3.

Toxicity assessment for environmental contaminants generally is accomplished in two steps: hazard identification and dose-response assessment. Hazard identification is the process of determining whether exposure to an agent can cause an increase in the incidence of a particular adverse health effect (e.g., cancer, birth defects) and whether the adverse health effect is likely to occur in humans. Hazard identification involves characterizing the nature and strength of the evidence of causation. Dose-response evaluation is the process of quantitatively evaluating the toxicity information and characterizing the relationship between the dose of the contaminant administered or received and the incidence of adverse health effects in the exposed population. From this quantitative dose-response relationship, toxicity values (e.g., reference doses and slope factors) are derived that can be used to estimate the incidence or potential for adverse effects as a function of human exposure to the agent. These toxicity values are used in the risk characterization step to estimate the likelihood of adverse effects occurring in humans at particular exposure levels.

2.3.1 Toxicity Assessment for Noncarcinogenic Effects

A reference dose, or RfD, is the toxicity value used most often in evaluating noncarcinogenic effects resulting from exposures at contaminated sites. Various types of RfDs are available depending on the exposure route (oral or inhalation), the critical effect (developmental or other), and the length of exposure being evaluated (chronic, subchronic, or single event). The oral RfDs

TABLE 2-6. EQUATIONS USED FOR ESTIMATING POTENTIAL DOSE

EXPOSURE ROUTE	EQUATION	PARAMETER DEFINITIONS
Ingestion of Soil	Native Northern Adults/Children $ADD \text{ or } LADD \ (mg/kg/day) = \frac{C_s * CF * EF}{AT} \sum_{i=1}^{n} \frac{IR_i * ED_i}{BW_i}$ DEW Line workers: $ADD \text{ or } LADD \ (mg/kg/day) = \frac{C_s * CF * IR * EF * ED}{BW * AT}$	C_s = concentration in soil (mg/kg) CF = conversion factor (10^{-6} kg/mg) IR = ingestion rate (mg/day) EF = exposure frequency (days/year) ED = exposure duration (years) BW = body weight (kg) AT = averaging time (days/year x years)
Ingestion of Surface Water	$ADD \text{ or } LADD \ (mg/kg/day) = \frac{C_w * CF * IR * EF * ED}{BW * AT}$	C_w = concentration in surface water (μg/L) CF = conversion faction (10^{-3} mg/μg) IR = ingestion rate (L/day) EF = exposure frequency (days/year) ED = exposure duration (years) BW = body weight (kg) AT = averaging time (days/year x years)

used to estimate the noncancer hazard associated with exposure to soils, sediments, and surface water at the Point Lonely installation are presented in Table 2-7.

A chronic RfD is defined as an estimate (with uncertainty spanning perhaps an order of magnitude or greater) of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime. Chronic RfDs are developed specifically to be protective for long-term exposure to a compound. Chronic RfDs generally should be used to evaluate the potential noncancerous effects associated with exposure periods between 7 years (approximately 10 percent of a human lifetime) and a lifetime. Many chronic RfDs have been reviewed and verified by the intra-Agency RfD Workgroup and entered into EPA's IRIS database.

2.3.1.1 Concept of Threshold. To limit noncancerous effects, humans and other animals have protective mechanisms that must be overcome before an adverse effect is manifested. For example, where a large number of cells perform the same or similar function, the cell population may have to be significantly depleted before the adverse effect is seen. As a result, a range of exposures from zero to some finite level exists that can be tolerated by the organism with essentially no chance of expression of adverse effects. In developing a toxicity value for evaluating noncancerous effects (i.e., an RfD), the approach is to identify the upper bound of this tolerance range (i.e., the maximum subthreshold level). Because variability exists among humans, attempts are made to identify a subthreshold level that protects sensitive individuals in the population. For most chemicals, this level can only be estimated; the RfD incorporates UF indicating the degree of extrapolation used to derive the estimated value. RfD summaries in IRIS also contain a statement expressing the overall confidence that the evaluators have in the RfD (high, medium, or low). The RfD is generally considered to have uncertainty spanning an order of magnitude or more, so the RfD should not be viewed as a strict scientific demarcation between levels that are toxic and nontoxic.

2.3.2 Toxicity Assessment For Carcinogenic Effects

A slope factor and the accompanying weight-of-evidence determination are the toxicity data most commonly used to evaluate potential human carcinogenic risks. The methods EPA uses to derive these values are outlined below. Additional information can be obtained by consulting EPA's *Guidelines for Carcinogen Risk Assessment* (EPA 1986a) and IRIS Background Document #2 (IRIS 1995). The slope factors for the COCs at Point Lonely are presented in Table 2-8.

2.3.2.1 Concept of Nonthreshold Effects. Risk evaluation based on the presumption of a dose-response threshold is generally thought to be inappropriate for carcinogens. In the evaluation of carcinogenicity, EPA assumes that a small number of molecular events can evoke changes in a single cell and lead to uncontrolled cellular proliferation and eventually to a clinical state of disease (cancer). This hypothesized mechanism for carcinogenesis is referred to as "nonthreshold" because all levels of exposure pose a finite probability of causing the development of cancer. That is, no dose is thought to be risk-free, and an effect threshold cannot be estimated.

TABLE 2-7. TOXICITY CRITERIA FOR NONCANCER EFFECTS OF THE CHEMICALS OF CONCERN FOR POINT LONELY

CHEMICAL	ORAL REFERENCE DOSE (RfD) (mg/kg-day)	TARGET ORGAN OR CRITICAL EFFECT (species)[a]	UNCERTAINTY FACTOR[b]	ORAL RfD SOURCE[c]
Barium	0.07	NOAEL (humans)	3	IRIS
Benzene	NA	NA	NA	NA
Chloromethane	NA	NA	NA	NA
cis-1,2-Dichloroethene	0.01	decreased hematocrit and hemoglobin (rat)	3,000	HEAST
DRPH	0.08[d]	liver effects (mice)	10,000	ECAO
GRPH	0.2[d]	decreased body weight (rats)	1000	ECAO
Manganese (water)	0.005	CNS effects (humans)	1	IRIS
Methylene chloride	0.06	liver toxicity (rat)	100	IRIS
4-Methylphenol	0.005	CNS effects, mortality (rabbit)	1,000	HEAST
RRPH	0.08[d]	liver effects (mice)	10,000	ECAO
Tetrachloroethene	0.01	liver effects (mice)	1,000	IRIS
Toluene	0.2	liver and kidney weight change (rat)	1,000	IRIS
Trichloroethene	NA	NA	NA	NA

a A target organ is the organ apparently most sensitive to the toxicity of a chemical. A critical effect is reported when EPA has not identified a target organ for the toxicity of a given chemical.
b The uncertainty factors (UF) used to develop oral reference doses are generally applied in multiples of 10 to account for shortcomings in the toxicological database. The greater the UF, the lower the confidence level that can be placed on that RfD. Factors of 10 are applied to account for each of the following: human variability in toxic response, extrapolation from animal studies to humans, extrapolation of short-term exposures to long-term exposures, and the extrapolation of a lowest-observed adverse effect level (LOAEL) to a no observed adverse effect level (NOAEL).
c Sources of oral RfD values are IRIS (Integrated Risk Information System), HEAST (Health Effects Assessment Summary Tables), or ECAO (The Environmental Criteria and Assessment Office of EPA).
d Oral RfD values for DRPH, GRPH, and RRPH are based on (EPA 1992b) and are considered provisional.
CNS Central nervous system.
NA Not available.
NOAEL The oral RFD for barium is based on a No Observed Adverse Effects Level in humans who received barium in drinking water.

TABLE 2-8. TOXICITY VALUES FOR THE CARCINOGENICITY OF THE CHEMICALS OF CONCERN AT POINT LONELY

CHEMICAL	WEIGHT-OF-EVIDENCE (WOE)	TUMOR TYPE (species)	ORAL SLOPE FACTOR (kg-day/mg)	ORAL SLOPE FACTOR SOURCE[a]
Barium	NA	NA	NA	IRIS
Benzene	A	leukemia (humans)	0.029	IRIS
Chloromethane	C	kidney (moose)	0.013	HEAST
cis-1,2-Dichloroethene	NA	NA	NA	IRIS
DRPH	NA	NA	NA	NA
GRPH	C	liver adenoma/carcinoma (mouse)	0.0017	ECAO
Manganese (water)	NA	NA	NA	IRIS
Methylene chloride	0.06	liver toxicity (rats)	100	IRIS
4-Methylphenol	C	NA	NA	IRIS
RRPH	NA	NA	NA	NA
Tetrachloroethene	C-B2	not specified	0.052	ECAO
Toluene	D	NA	NA	IRIS
Trichloroethene	C-B2	not specified	0.011	ECAO

a IRIS, Integrated Risk Information System; ECAO, Environmental Criteria and Assessment Office of EPA; HEAST, Health Effects Assessment Summary Tables, EPA.

NA Not available.

2.3.2.2 Assigning a Weight-of-Evidence. In the first step of the evaluation, the carcinogenicity data are evaluated to determine the likelihood that the agent is a human carcinogen. The evidence is characterized separately for human studies and animal studies as sufficient, limited, inadequate, no data, or evidence of no effect. The characterizations of these two types of data are combined, and based on the extent to which the agent has been shown to be a carcinogen in experimental animals, humans, or both, the agent is given a provisional weight-of-evidence classification. EPA scientists then adjust the provisional classification upward or downward based on other supporting evidence of carcinogenicity.

The EPA classification system for weight-of-evidence is shown in Table 2-9.

2.3.2.3 Generating a Slope Factor. For chemicals classified as known or probable human carcinogens, a toxicity value that defines quantitatively the relationship between dose and response (i.e., the slope factor) is calculated. Slope factors (SFs) typically are calculated for potential carcinogens in classes A, B1, and B2. Quantitative estimation of slope factors for the chemicals in class C is done on a case-by-case basis.

Generally, the slope factor is a plausible upper-bound estimate of the probability of a response per unit intake of a chemical over a lifetime. The slope factor is used in risk assessments to estimate an upper-bound lifetime probability of an individual developing cancer as a result of exposure to a particular level of a potential carcinogen. Slope factors should always be accompanied by the weight-of-evidence classification to indicate the strength of the evidence that the agent is a human carcinogen.

TABLE 2-9. EPA WEIGHT-OF-EVIDENCE CLASSIFICATION SYSTEM FOR CARCINOGENICITY

GROUP	DESCRIPTION
A	Human carcinogen.
B1 or B2	Probable human carcinogen.
	B1 indicates that limited human data are available.
	B2 indicates sufficient evidence in animals and inadequate or no evidence in humans.
C	Possible human carcinogen.
D	Not classifiable as to human carcinogenicity.
E	Evidence of noncarcinogenicity for humans.

2.3.2.4 Identifying the Appropriate Data Set. In deriving slope factors, the available information about a chemical is evaluated and an appropriate data set is selected; human data of high quality are preferable to animal data. If animal data are used, the species that responds most similarly to humans (with respect to factors such as metabolism, physiology, and pharmacokinetics) is preferred. When no clear choice is possible, the most sensitive species is given the greatest emphasis. Occasionally, in situations where no single study is judged most appropriate yet several studies collectively support the estimate, the geometric mean of estimates from all studies may be adopted as the slope factor. This practice ensures the inclusion of all relevant data.

2.3.2.5 Extrapolating to Lower Doses. Because risk at low exposure levels is difficult to measure directly either by animal experiments or by epidemiologic studies, the development of a slope factor generally entails applying a model to the available data set and using the model to extrapolate from the relatively high doses administered to experimental animals (or the exposures noted in epidemiologic studies) to the lower exposure levels expected for human contact in the environment.

A number of mathematical models and procedures have been developed to extrapolate from carcinogenic responses observed at high doses to responses expected at low doses. Different extrapolation methods may provide a reasonable fit to the observed data but may lead to large differences in the projected risk at low dose.

In general, after the data are fit to the appropriate model, the upper 95th percent confidence limit of the slope of the resulting dose-response curve is calculated. This value is known as the slope factor and represents an upper 95th percent confidence limit on the probability of a response per unit intake of a chemical over a lifetime (i.e., there is only a 5 percent chance that the probability of a response could be greater than the estimated value on the basis of the experimental data and model used). In some cases, slope factors based on human dose-response data are based on the "best" estimate instead of the upper 95th percent confidence limits. Because the dose-response curve generally is linear only in the low-dose region, the slope factor estimate only holds true for low doses. Information concerning the limitations on use of slope factors can be found in IRIS.

2.3.2.6 Summary of Dose-Response Parameters. Toxicity values for carcinogenic effects can be expressed in several ways. The slope factor generally is considered to be the upper 95th percent confidence limit of the slope of the dose-response curve and is expressed as $(\text{mg/kg-day})^{-1}$. Thus:

$$\begin{aligned}\text{Slope factor} &= \text{risk per unit dose} \\ &= \text{risk per mg/kg-day}\end{aligned}$$

Where data permit, slope factors listed in IRIS are based on absorbed doses, although many of them have been based on administered doses.

2.3.3 Summaries of the Toxicity of the Chemicals of Concern

Tables 2-7 and 2-8 present chronic cancer and noncancer health effects criteria (oral slope factors and RfDs, respectively, for the COCs). The toxicological properties of the COCs and the toxicological basis of the health effects criteria listed in Tables 2-7 and 2-8 are discussed in Appendix B.

2.4 RISK CHARACTERIZATION

In the risk characterization, the toxicity and exposure assessments are summarized and integrated into quantitative and qualitative expressions of risk. To characterize potential noncancerous effects, comparisons are made between projected intakes (ADD) of substances and toxicity values (e.g., the RfD). To characterize potential carcinogenic effects, probabilities that an individual will develop cancer over a lifetime of exposure are estimated from projected intakes (LADD) and chemical-specific dose-response information (e.g., the slope factor). Major assumptions, scientific judgements, and to the extent possible, estimates of the uncertainties embodied in the assessment are also presented. In this section, methods of quantifying risks are discussed and applied to individual sites at the Point Lonely installation.

2.4.1 Quantifying Risks

This section describes the steps for quantifying risk or hazard indices for both carcinogenic and noncancerous effects to be applied to each exposure pathway analyzed. The first two subsections cover procedures for individual substances and are followed by a subsection on procedures for quantifying risks associated with simultaneous exposures to several substances.

2.4.1.1 Risks from Individual Substances - Carcinogenic Effects. For carcinogens, risks are estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen (i.e., incremental or excess individual lifetime cancer risk). The guidelines provided in this section are consistent with EPA (1986a). For some carcinogens, there may be sufficient information on mechanism of action that a modification of the approach outlined below is warranted. Alternative approaches may be considered in consultation with ECAO on a case-by-case basis.

The slope factor converts estimated daily intakes averaged over a lifetime of exposure directly to incremental risk of an individual developing cancer. Because environmental exposure is likely to result in relatively low intakes (compared to those experienced by test animals), it generally can be assumed that the dose-response relationship will be linear in the low-dose portion of the multistage model dose-response curve. Under this assumption the slope factor is a constant, and risk will be directly related to intake. Thus, the linear form of the carcinogenic risk equation is usually applicable for estimating cancer risks. This linear low-dose equation is described below.

LINEAR LOW-DOSE CANCER RISK EQUATION

Risk = LADD x SF

where:

Risk = a unitless probability (e.g., 2×10^{-5}) of an individual developing cancer;

LADD = lifetime average daily dose averaged over 70 years (mg/kg-day); and

SF = slope factor, expressed in $(mg/kg\text{-}day)^{-1}$

Because the slope factor is often an upper 95th percentile confidence limit of the probability of response based on experimental animal data used in the multistage model, the carcinogenic risk estimate generally will be an upper-bound estimate. This means that the "true risk" will probably not exceed the risk estimate derived through use of this model and is likely to be lower than predicted.

2.4.1.2 Noncancer Hazards from Individual Substances - Noncancerous Effects. The measure used to describe the potential for noncancerous toxicity in an individual is not expressed as the probability of an individual suffering an adverse effect. EPA does not at the present time use a probabilistic approach to estimate the potential for noncancerous health effects. Instead, the potential for noncancerous effects is evaluated by comparing an exposure level over a specified time period (e.g., some fraction of a lifetime) with a reference dose derived for a similar exposure period. This ratio of exposure to toxicity is called a hazard quotient (HQ).

The noncancer HQ assumes there is a level of exposure (i.e., the RfD) below which it is unlikely even for sensitive populations to experience adverse health effects. If the exposure level (ADD) exceeds this threshold (i.e., if ADD/RfD exceeds unity), there may be concern for potential noncancer effects. As a rule, the greater the value of ADD/RfD above unity, the greater the level of concern. Ratios of ADD/RfD should not be interpreted as statistical probabilities; a ratio of 0.001 does not mean that there is a one in one thousand chance of the effect occurring. Further, it is important to emphasize that the level of concern does not increase linearly as the RfD is approached or exceeded because RfDs do not have equal accuracy or precision and are not based on the same severity of toxic effects. Thus, the slopes of the dose-response curve in excess of the RfD can range widely depending on the substance.

NONCANCER HAZARD QUOTIENT

Noncancer Hazard Quotient = ADD/RfD

where:

ADD = average daily dose (or intake) and

RfD = reference dose.

ADD and RfD are expressed in the same units and represent the same exposure period (e.g., chronic, subchronic, or short-term).

2.4.1.3 Aggregate Risks for Multiple Substances. Estimating risk or hazard potential by considering one chemical at a time might significantly underestimate the risks associated with simultaneous exposures to several substances. To assess the overall potential for cancer and noncancer effects posed by multiple chemicals, EPA has developed *Guidelines for the Health Risk Assessment of Chemical Mixtures* (EPA 1986b). These guidelines can be applied to the case of simultaneous exposures to several chemicals from a variety of sources by more than one exposure pathway. Information on specific mixtures is rarely available. Even if such data exist, they are often difficult to use. Monitoring for "mixtures" or modeling the movement of mixtures across space and time present significant technical problems given the likelihood that individual components will behave differently in the environment (i.e., fate and transport).

Although the calculation procedures differ for carcinogenic and noncarcinogenic effects, both sets of procedures assume dose additivity in the absence of information on specific mixtures.

Carcinogenic Effects. The cancer risk equation described below is used to estimate the incremental individual lifetime cancer risk for simultaneous exposure to several carcinogens based on EPA's risk assessment guidelines. This equation represents an approximation of the precise equation for combining risks which accounts for the joint probabilities of the same individual developing cancer as a consequence of exposure to two or more carcinogens. The difference between the precise equation and the approximation described in the equation below is negligible for total cancer risks less than 0.1. Thus, the simple additive equation is appropriate for most risk assessments.

CANCER RISK EQUATION FOR MULTIPLE SUBSTANCES

$$Risk_T = \Sigma\ Risk_i$$

where:

$Risk_T$ = the total cancer risk, expressed as a unitless probability; and

$Risk_i$ = the risk estimate for the i^{th} substance.

The risk summation techniques described in the cancer risk equation above assume that intakes of individual substances are small. They also assume independence of action by the compounds involved (i.e., there are no synergistic or antagonistic chemical interactions and all chemicals produce the same effect, i.e., cancer). If these assumptions are incorrect, over- or under-estimation of the actual multiple-substance risk could result.

A separate total cancer risk for each exposure pathway is calculated by summing the substance-specific cancer risks. Resulting cancer risk estimates should be expressed using one significant figure only.

There are several limitations to this approach. First, because each slope factor is an upper 95th percentile estimate of potency and upper 95th percentiles of probability distributions are not strictly additive, the total cancer risk estimate might artificially become more conservative as risks from a number of different carcinogens are summed. If one or two carcinogens drive the risk, however, this problem is not of concern. Second, it often will be the case that substances with

different weights of evidence for human carcinogenicity are included. The cancer risk equation for multiple substances sums all carcinogens equally, giving as much weight to class B or C as to class A carcinogens. In addition, slope factors derived from animal data will be given the same weight as slope factors derived from human data. Finally, the action of two different carcinogens might not be independent.

Noncancerous Effects. To assess the overall potential for noncancerous effects posed by more than one chemical, a hazard index approach has been developed based on EPA's *Guidelines for Health Risk Assessment of Chemical Mixtures* (EPA 1986b). This approach assumes that simultaneous subthreshold exposures to several chemicals could result in an adverse health effect. It also assumes that the magnitude of the adverse effect will be proportional to the sum of the ratios of the subthreshold exposures. The hazard index (HI) is equal to the sum of the HQs. When the hazard index exceeds unity, there may be concern for potential health effects. Any single chemical with an exposure level greater than the toxicity value will cause the hazard index to exceed unity, and for multiple chemical exposures, the hazard index can exceed unity even if no single chemical exposure exceeds its RfD. The equation used to determine noncancer hazard index is as follows:

NONCANCER HAZARD INDEX

$$\text{Hazard Index} = ADD_1/RfD_1 + ADD_2/RfD_2 + \ldots + ADD_i/RfD_i$$

where:

ADD_i = average daily dose (or intake) for the i^{th} toxicant;

RfD_i = reference dose for the i^{th} toxicant; and

ADD and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or shorter-term).

Where appropriate, a separate chronic hazard index can be calculated from the ratios of the chronic daily intake (CDI) to the chronic reference dose (RfD) for individual chemicals as described below.

CHRONIC NONCANCER HAZARD INDEX

$$\text{Chronic Hazard Index} = LADD_1/RfD_1 + LADD_2/RfD_2 + \ldots + LADD_i/RfD_i$$

where:

$LADD_i$ = lifetime average daily dose for the i^{th} toxicant in mg/kg-day, and

RfD_i = chronic reference dose for the i^{th} toxicant in mg/kg-day.

There are several limitations to this approach. As mentioned earlier, the level of concern does not increase linearly as the RfD is approached or exceeded because the RfDs do not have equal accuracy or precision and are not based on the same severity of effect. Moreover, HQs are combined for substances with RfDs based on critical effects of varying toxicological significance.

It will often be the case that RfDs of varying levels of confidence, including different uncertainty adjustments and modifying factors, will be combined (e.g., extrapolation from animals to humans, from LOAELs to NOAELs, and from one exposure duration to another).

Another limitation with the hazard index approach is that the assumption of dose additivity is most properly applied to compounds that induce the same effect by the same mechanism of action. Consequently, application of the hazard index equation to a number of compounds that are not expected to induce the same type of effects or that do not act by the same mechanism could overestimate the potential for effects. Such an approach is, however, appropriate at a screening level. This possibility is generally not of concern if only one or two substances are responsible for driving the hazard index above unity. If the hazard index is greater than unity as a consequence of summing several HQs of similar value, it is appropriate to segregate the compounds by effect and by mechanism of action and derive separate hazard indices for each group.

2.4.2 Site-Specific Risk Characterization

Soil and Sediment Exposures. The quantification of noncancer hazard and excess lifetime cancer risk associated with the soil ingestion pathway at the Point Lonely installation was based on analytical data from soil and sediment samples collected within the interval from ground surface to permafrost. No attempt was made to segregate surface soil samples from subsurface samples in the human health risk characterization.

The noncancer hazard and the excess lifetime cancer risk associated with the ingestion of soil or sediment containing COCs has been estimated for a hypothetical native northerner based on six years of exposure as a child and 49 years of exposure as an adult. For the DEW Line worker, cancer risk has been estimated based on ten years of exposure averaged over a default lifetime of 70 years. Noncancer hazard for the DEW Line worker was based on a 10 year exposure.

Surface Water Exposures. The noncancer hazard and the excess lifetime cancer risk associated with the ingestion of surface water containing COCs has been estimated based on a native northern adult and a DEW Line worker. A native northern child receptor was not considered because, unlike exposure to soil, which is expected to be greater in a child than in an adult, the ratio of drinking water ingestion rate to body weight is assumed to be relatively constant from childhood to adulthood. A greater number of years is spend as an adult, so estimating hazard or risk for water ingestion based on an adult is a more conservative approach. The exposure duration estimate for the DEW Line worker was 10 years and for the native northern adult was 55 years. Exposures were averaged over 10 years for DEW Line worker exposure to noncarcinogens, and 55 years for native northern adult exposure to noncarcinogens. Exposures were averaged over 70 years for both receptor groups to characterize the risk associated with exposure to carcinogens in surface water.

Ingestion of surface water at the Point Lonely installation is not considered to be a complete pathway under a current use scenario; the installation has been automated for unmanned operation and is located approximately 70 miles from the nearest village. Under a future use scenario, however, it is possible that the buildings could be used for residences or additional

residential structures could be erected at the installation. The future residents could be either DEW Line workers or native northerners. Therefore, because sources of water may change in the future, potential ingestion of surface water at the installation will be evaluated for the DEW Line worker and native northern adult under a future use exposure scenario only.

Table 2-10 contains a site-by-site summary of the COCs in each medium, and the noncancer hazard and excess lifetime cancer risk associated with exposure to the COCs in the soils, sediments, and surface water. COCs without toxicity data are not included on Table 2-10, but are discussed in Section 2.1.5. Appendix A contains the spreadsheets used to calculate the noncancer hazard and excess lifetime cancer risk estimates presented in Table 2-9.

Risk Characterization of Petroleum Hydrocarbons. Petroleum hydrocarbons represent a primary source of contamination at the Point Lonely installation. The laboratory analysis of soil, sediment, and surface water samples revealed the presence of DRPH, GRPH, and RRPH. To characterize the risk associated with exposure to these compounds, the provisional RfDs and the slope factor developed by EPA for petroleum hydrocarbons were applied (EPA 1992b). These provisional RfDs provide the best available tool for characterizing the risk associated with exposure to the petroleum hydrocarbons. The RfD for JP-4 presented in EPA (1992b) was used to represent DRPH and RRPH, and the RfD and slope factor for unleaded gasoline were used to represent GRPH.

The noncancer hazard associated with exposure to DRPH, GRPH, and RRPH was, therefore, estimated by dividing the compound- and site-specific ADD by the appropriate provisional RfD (EPA 1992b). The excess lifetime cancer risk associated with exposure to GRPH were estimated by multiplying the compound- and site-specific LADD by the slope factor for unleaded gasoline (EPA 1992b).

Although the provisional RfDs and slope factor represent the best available numerical estimate of toxicity, there is a significant amount of uncertainty associated with their use at the Point Lonely installation. The RfDs and slope factor are based on studies in mice and rats by the inhalation route of exposure; however, for this risk assessment, exposure of humans by the ingestion route is being evaluated. Furthermore, in the absence of a more thorough study to compare the DRPH, GRPH, and RRPH to known petroleum refinery streams, it is not clear how well the provisional values represent the toxicity of diesel and gasoline in humans.

Risk Characterization of Chemicals Detected. Chemicals detected above background levels without RBSLs or ARARs are evaluated in Section 2.1.5 (page 2-6). Based on the information in that section, and the relatively low levels detected at the sites, these chemicals are not expected to pose a health risk. Risk characterization of chemicals detected that exceed RBSLs, ARARs, or both are discussed on a site-by-site basis below.

2.4.2.1 Sewage Disposal Area (SS01).

Soils or Sediments. The noncancer hazard associated with the ingestion of soil at the Sewage Disposal Area by a hypothetical native northern adult/child is 0.2, and by a DEW Line worker is 0.006, based on the maximum concentrations of the COCs (Table 2-10 and A-1). The presence

TABLE 2-10. SUMMARY OF NONCANCER HAZARD AND EXCESS LIFETIME CANCER RISK FOR POINT LONELY

SITE	MEDIUM	NONCANCER CHEMICALS OF CONCERN[a]	NONCANCER HAZARD[c]			CARCINOGENIC CHEMICALS OF CONCERN[a]	EXCESS LIFETIME CANCER RISK[d]		
			DEW LINE WORKER	NATIVE NORTHERN ADULT	NATIVE NORTHERN ADULT/CHILD		DEW LINE WORKER	NATIVE NORTHERN ADULT	NATIVE NORTHERN ADULT/CHILD
Sewage Disposal Area (SS01)	Soil or Sediment	DRPH GRPH	0.006	—[e]	0.2	GRPH	7×10^{-9}	—[e]	3×10^{-7}
	Surface Water	NONE[b]	—	—	—[f]	Benzene Chloromethane	2×10^{-8}	**2×10^{-6}**	—[f]
Drum Storage Area (ST02)	Soil or Sediment	DRPH Tetrachloroethene	<0.001	—	0.02	Tetrachloroethene	4×10^{-10}	—	2×10^{-8}
	Surface Water	Toluene	0.008	0.1	—	Benzene	**2×10^{-6}**	**2×10^{-4}**	—
Beach Diesel Tanks (SS03)	Soil or Sediment	DRPH GRPH	0.005	—	0.2	GRPH	1×10^{-9}	—	4×10^{-8}
	Surface Water	NONE	—	—	—	NONE	—	—	—
POL Storage (SS04)	Soil or Sediment	Tetrachloroethene	<0.001	—	0.001	Benzene Tetrachloroethene Trichloroethene	4×10^{-9}	—	9×10^{-8}
	Surface Water	GRPH cis-1,2-Dichloroethene Methylene chloride Tetrachloroethene Toluene 4-Methylphenol Barium Manganese	**1.0**	**14**	—	GRPH Benzene Methylene chloride Tetrachloroethene Trichloroethene	**2×10^{-6}**	**2×10^{-3}**	—
Diesel Spills (SS05)	Soil or Sediment	DRPH GRPH	0.001	—	0.07	GRPH Benzene	9×10^{-10}	—	4×10^{-8}
	Surface Water	GRPH	0.001	0.02	—	GRPH Benzene	**2×10^{-6}**	**1×10^{-5}**	—
Old Dump Site (LF07)	Soil or Sediment	RRPH	0.002	—	0.09	NONE	—	—	—
	Surface Water	NONE	—	—	—	NONE	—	—	—

TABLE 2-10. SUMMARY OF NONCANCER HAZARD AND EXCESS LIFETIME CANCER RISK FOR POINT LONELY (CONTINUED)

SITE	MEDIUM	NONCANCER CHEMICALS OF CONCERN[a]	NONCANCER HAZARD[c]			CARCINOGENIC CHEMICALS OF CONCERN[a]	EXCESS LIFETIME CANCER RISK[d]		
			DEW LINE WORKER	NATIVE NORTHERN ADULT	NATIVE NORTHERN ADULT/CHILD		DEW LINE WORKER	NATIVE NORTHERN ADULT	NATIVE NORTHERN ADULT/CHILD
Garage (SS09)	Soil or Sediment	DRPH GRPH RRPH Tetrachloroethene	0.009	—	0.4	GRPH Tetrachloroethene	6×10^{-9}	—	3×10^{-7}
	Surface Water	Barium	0.005	0.06	—	Benzene	9×10^{-9}	6×10^{-7}	—
Diesel Tank (ST10)	Soil or Sediment	DRPH GRPH	<0.001	—[e]	0.02	GRPH	3×10^{-9}	—[e]	1×10^{-7}
	Surface Water	NONE[b]	—	—	—[f]	NONE	—	—	—[f]
Inactive Landfill (LF11)/Vehicle Storage Area (SS14)	Soil or Sediment	NONE	—	—	—	NONE	—	—	—
	Surface Water	GRPH Barium	0.007	0.08	—	GRPH Benzene	9×10^{-7}	**5×10^{-6}**	—
Module Train (SS12)	Soil or Sediment	NONE	—	—	—	NONE	—	—	—
	Surface Water	NONE	—	—	—	NONE	—	—	—
Hangar Pad Area (SS13)	Soil or Sediment	NONE	—	—	—	NONE	—	—	—
	Surface Water	NONE	—	—	—	NONE	—	—	—

BOLD Bold text indicates that the value exceeds a noncancer hazard index of 1.0 or an excess lifetime cancer risk of 1×10^{-6}

— Not applicable, because no chemicals of concern were identified.

a All COCs are listed together regardless of whether they contribute to the hazard index, cancer risk, or both.

b None, no COCs selected.

c Hazard index, noncancer hazard index. The hazard index is the sum of the hazard quotients for all of the COCs associated with a given medium, pathway, and receptor group.

d Cancer risk, excess lifetime cancer risk. The cancer risk is the sum of the excess lifetime cancer risks for all of the carcinogenic COCs associated with a given medium, pathway, and receptor group.

e Children are assumed to have a soil ingestion rate greater than that for adults. Therefore, under a residential scenario, the estimates of noncancer hazard and cancer risk associated with soil ingestion are estimated for a combined adult and child receptor only. This estimate is considered a conservative upper bound of the true hazard of risk.

f Drinking water ingestion, unlike soil ingestion, is evaluated for an adult receptor but not a child receptor because adults are assumed to have a longer exposure duration at a greater water ingestion rate. Therefore, the hazard or risk estimated will represent an upper bound, conservative estimate. For soil ingestion, the child soil ingestion rate is assumed to exceed that for adults. Therefore, a combination of the adult and child receptor groups is used to evaluate soil ingestion risk and hazard.

of DPRH and GRPH accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations.

The excess lifetime cancer risk associated with the ingestion of soil at the site by a hypothetical native northern adult/child is 3×10^{-7}, and by a DEW Line worker is 7×10^{-9}, based on the maximum concentration of the COC (Table 2-10 and A-2). The presence of GRPH accounts entirely for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

Surface Water. No COCs were selected for the surface water at the Sewage Disposal Area based on noncancer hazard (Table 2-10). This does not indicate that exposure to the surface water is without noncancer effects, but rather that noncancer effects, if any, cannot be quantified.

The excess lifetime cancer risk associated with the ingestion of surface water at the site by a hypothetical native northern adult is 2×10^{-6}, and by a DEW Line worker is 2×10^{-8}, based on the maximum concentration of the COCs (Table A-4). The presence of benzene and chloromethane accounts entirely for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

2.4.2.2 Drum Storage Area (ST02).

Soils or Sediments. The noncancer hazard associated with the ingestion of soil at the Drum Storage Area by a hypothetical native northern adult/child is 0.02, and by a DEW Line worker is <0.001, based on the maximum concentrations of the COCs (Table 2-10 and A-1). The presence of DRPH and tetrachloroethene accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations.

The excess lifetime cancer risk associated with the ingestion of soil at the site by a hypothetical native northern adult/child is 2×10^{-8}, and by a DEW Line worker is 4×10^{-10}, based on the maximum concentration of the COC (Table 2-10 and A-2). The presence of tetrachloroethene accounts entirely for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

Surface Water. The noncancer hazard associated with the ingestion of surface water at the Drum Storage Area by a hypothetical native northern adult is 0.1, and by a DEW Line worker is 0.008 based on the maximum concentration of the COC (Table 2-10 and A-6). The presence of toluene accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations.

The excess lifetime cancer risk associated with the ingestion of surface water at the site by a hypothetical native northern adult is 2×10^{-4}, and by a DEW Line worker is 2×10^{-6}, based on the maximum concentration of the COC (Table A-7). The presence of benzene accounts entirely for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

2.4.2.3 Beach Diesel Tanks (SS03).

Soils or Sediments. The noncancer hazard associated with the ingestion of soil at the Beach Diesel Tanks site by a hypothetical native northern adult/child is 0.2, and by a DEW Line worker is 0.005, based on the maximum concentrations of the COCs (Table 2-10 and A-8). The presence of DPRH and GRPH accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations.

The excess lifetime cancer risk associated with the ingestion of soil at the site by a hypothetical native northern adult/child is 4×10^{-8}, and by a DEW Line worker is 1×10^{-9}, based on the maximum concentration of GRPH (Table 2-10 and A-9). The presence of GRPH accounts entirely for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

Surface Water. No COCs were identified for the surface water at the Beach Diesel Tanks site (Table 2-1). This does not indicate that exposure to chemicals in the surface water at the site is without health risk; however, no chemicals were measured at concentrations that exceeded the detection limits of the surface water analysis protocol.

2.4.2.4 POL Storage (SS04).

Soils or Sediments. The noncancer hazard associated with the ingestion of soil at the POL Storage site by a hypothetical native northern adult/child is 0.001, and by a DEW Line worker is <0.001, based on the maximum concentration of the COC (Table 2-10 and A-10). The presence of tetrachloroethene accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations.

The excess lifetime cancer risk associated with the ingestion of soil at the site by a hypothetical native northern adult/child is 9×10^{-8}, and by a DEW Line worker is 4×10^{-9}, based on the maximum concentrations of the COCs (Table 2-10 and A-11). The presence of benzene, tetrachloroethene, and trichloroethene accounts entirely for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

Surface Water. The noncancer hazard associated with the ingestion of surface water at the POL Storage site by a hypothetical native northern adult is 14, and by a DEW Line worker is 1.0 based on the maximum concentrations of the COCs (Table 2-10 and A-12). Several chemicals contribute to the noncancer hazard; however, manganese, tetrachloroethene, and cis-1,2-dichloroethene contribute more than 99 percent of the quantifiable noncancer hazard for these receptor/pathway combinations.

The excess lifetime cancer risk associated with the ingestion of surface water at the site by a hypothetical native northern adult is 2×10^{-3}, and by a DEW Line worker is 2×10^{-6}, based on the maximum concentrations of the COCs (Tables 2-10 and A-13). Several chemicals (GRPH, benzene, methylene chloride, tetrachloroethene, and trichloroethene) contribute to the excess lifetime cancer risk; however, tetrachloroethene contributes about 75 percent of the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

2.4.2.5 Diesel Spills (SS05).

Soils or Sediments. The noncancer hazard associated with the ingestion of soil at the Diesel Spill site by a hypothetical native northern adult/child is 0.07, and by a DEW Line worker is 0.001, based on the maximum concentrations of the COCs (Tables 2-10 and A-14). The presence of DRPH and GRPH accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations.

The excess lifetime cancer risk associated with the ingestion of soil at the site by a hypothetical native northern adult/child is 4×10^{-8}, and by a DEW Line worker is 9×10^{-10} (Table 2-10 and A-15). The presence of GRPH and benzene accounts entirely for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

Surface Water. The noncancer hazard associated with the ingestion of surface water at the Diesel Spill site by a hypothetical native northern adult is 0.02, and by a DEW Line worker is 0.001, based on the maximum concentrations of the COC (Table 2-10 and A-16). The presence of GRPH accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations.

The excess lifetime cancer risk associated with the ingestion of surface water at the site by a hypothetical native northern adults is 1×10^{-5}, and by a DEW Line worker is 2×10^{-6}, based on the maximum concentrations of the COCs (Tables 2-10 and A-17). The presence of GRPH and benzene accounts entirely for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

2.4.2.6 Old Dump Site (LF07).

Soils or Sediments. The noncancer hazard associated with the ingestion of soil at the Old Dump Site by an hypothetical native northern adult/child is 0.09, and by a DEW Line worker is 0.002, based on the maximum concentration of the COC (Table 2-10 and A-18). The presence of RRPH accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations.

No COCs were identified for the soils or sediments at the site based on excess lifetime cancer risk (Table 2-1). This does not indicate that exposure to the soil or sediment is without cancer risk, but rather that cancer risks, if any, cannot be quantified.

Surface Water. No COCs were identified for the surface water at the Old Dump Site (Table 2-1). This does not indicate that exposure to chemicals in the surface water at the site is without health risk; however, no chemicals were measured at concentrations that exceeded the detection limits of the surface water analysis protocol.

2.4.2.7 Garage (SS09).

Soils or Sediments. The noncancer hazard associated with the ingestion of soil at the Garage by a hypothetical native northern adult/child is 0.4, and by a DEW Line worker is 0.009, based

on the maximum concentrations of the COCs (Table 2-10 and A-19). The presence of DPRH, GRPH, RRPH, and tetrachloroethene account for the quantifiable noncancer hazard for these receptor/pathway combinations. DRPH and RRPH together account for more than 90 percent of the noncancer hazard.

The excess lifetime cancer risk associated with the ingestion of soil at the site by a hypothetical native northern adult/child is 3×10^{-7}, and by a DEW Line worker is 6×10^{-9} (Table 2-10 and A-20). The presence of GRPH and tetrachloroethene accounts for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

Surface Water. The noncancer hazard associated with the ingestion of surface water at the Garage by a hypothetical native northern adult is 0.06, and by a DEW Line worker is 0.005, based on the maximum concentration of the COC (Table 2-10 and A-16). The presence of barium accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations.

The excess lifetime cancer risk associated with the ingestion of surface water at the site by a hypothetical native northern adult is 6×10^{-7}, and by a DEW Line worker is 9×10^{-9}, based on the maximum concentration of the COC (Table A-22). The presence of benzene accounts entirely for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

2.4.2.8 Diesel Tank (ST10).

Soils or Sediments. The noncancer hazard associated with the ingestion of soil at the Diesel Tank site by a hypothetical native northern adult/child is 0.02, and by a DEW Line worker is <0.001, based on the maximum concentrations of the COCs (Table 2-10 and A-23). The presence of DPRH and GRPH accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations.

The excess lifetime cancer risk associated with the ingestion of soil at the site by a hypothetical native northern adult/child is 1×10^{-7}, and by a DEW Line worker is 3×10^{-9}, based on the maximum concentration of the COC (Table 2-10 and A-24). The presence of GRPH accounts entirely for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

Surface Water. No COCs were selected for the surface water at the Diesel Tank site. This does not indicate that exposure to chemicals in the soil at the site is without health risk; however, the concentrations measured were below concentrations considered acceptable under Region 10 guidance (EPA 1991a) or federal ARARs.

2.4.2.9 Inactive Landfill (LF11)/Vehicle Storage Area (SS14).

Soils and Sediments. No COCs were selected for the soil at the Inactive Landfill/Vehicle Storage Area site (Table 2-1). This does not indicate that exposure to chemicals in the soil at the site is without health risk; however, the concentrations measured were below concentrations considered acceptable under Region 10 guidance (EPA 1991a) or federal ARARs.

Surface Water. The noncancer hazard associated with the ingestion of surface water at the Inactive Landfill/Vehicle Storage Area site by a hypothetical native northern adult is 0.08, and by a DEW Line worker is 0.007, based on the maximum concentrations of the COCs (Table 2-10 and A-25). The presence of GRPH and barium accounts entirely for the quantifiable noncancer hazard for these receptor/pathway combinations.

The excess lifetime cancer risk associated with the ingestion of surface water at the site by a hypothetical native northern adult is 5×10^{-6}, and by a DEW Line workers is 9×10^{-7}, based on the maximum concentrations of the COCs (Table 2-10 and A-26). The presence of GRPH and benzene accounts entirely for the quantifiable excess lifetime cancer risk for these receptor/pathway combinations.

2.4.2.10 Module Train (SS12).

Soils and Sediments. No COCs were selected for the soil at the Module Train (Table 2-1). This does not indicate that exposure to chemicals in the soil at the site is without health risk; however, the concentrations measured were below concentrations considered acceptable under Region 10 guidance (EPA 1991a) or federal ARARs.

Surface Water. No COCs were identified for the surface water at the Module Train site (Table 2-1). This does not indicate that exposure to chemicals in the surface water at this site is without health risk; however, the concentrations measured were below concentrations considered acceptable under Region 10 guidance (EPA 1991a) or federal ARARs.

2.4.2.11 Hangar Pad Area (SS13).

Soils and Sediments. No COCs were selected for the soil at the Hangar Pad Area (Table 2-1). This does not indicate that exposure to chemicals in the soil at the site is without health risk; however, the concentrations measured were below concentrations considered acceptable under Region 10 guidance (EPA 1991a) or federal ARARs.

Surface Water. No COCs were identified for the surface water at the Hangar Pad Area (Table 2-1). This does not indicate that exposure to chemicals in the surface water at the site is without health risk; however, the concentrations measured were below concentrations considered acceptable under Region 10 guidance (EPA 1991a) or federal ARARs.

2.5 RISK CHARACTERIZATION UNCERTAINTY

Several sources of uncertainty affect the estimates of excess lifetime cancer risk and noncancer hazard as presented in this risk assessment. The sources are generally associated with:

- Sampling and analysis of soil, sediment, and surface water;
- Assigning the source of contamination;

- Exposure assumptions, including estimates of exposure point concentrations;
- Evaluation of the toxicity of the COCs; and
- Methods and assumptions used to characterize the cancer risk and noncancer hazard.

Uncertainties associated with sampling and analyses include the inherent variability (standard error) in the analyses, representativeness of the samples, sampling errors, and heterogeneity of the sample matrix. The quality assurance/quality control program used in conducting the sampling and analyses serves to reduce errors, but it can not eliminate all errors associated with sampling and analyses. There is some uncertainty in the selection of COCs with respect to sample quantitation limits for a given chemical. In some cases a chemical may have had detected values below the COC screening criteria as well as samples with quantitation limits greater than the screening criteria. In these cases it should be understood that only the samples with adequate quantitation limits are applicable to the screening process. Thus, the number of samples used to screen a chemical would be less than the total number of analyses for that chemical.

Simplifying assumptions were made about the environmental fate and transport of the site contamination, specifically, that no contaminant loss or transformation occurs. Thus, the data chosen to represent exposure point concentrations in the sample-by-sample risk calculations are an additional source of potential error.

The depth at which a soil sample was collected was not considered in the risk characterization, so exposure to subsurface contamination was considered to be equally likely as exposure to surface contamination. This approach would tend to overestimate the true risk.

The estimation of exposure requires many assumptions to describe potential exposure situations. There are uncertainties regarding the likelihood of exposure, frequency of contact with contaminated media, the concentration of contaminants at exposure points, and the time period of exposure. These tend to simplify and approximate actual site conditions. In general, these assumptions are intended to be conservative and yield an overestimate of the true risk or hazard.

The toxicological database is also a source of uncertainty. The EPA has outlined some of the sources of uncertainty in the database (EPA 1986a,b, 1989a). These sources include extrapolation between exposure routes, from high to low doses, and from animals to humans; species, gender, age, and strain differences in uptake, metabolism, organ distribution, and target site susceptibility; and human population variability with respect to diet, environment, activity patterns, and cultural factors. The toxicity factors from IRIS and HEAST, which are used to estimate the toxicity of the COCs, are developed using a highly conservative methodology and probably tend to overestimate the potential hazards to humans.

Use of the provisional RfDs and SFs for DRPH, GRPH, and RRPH are an additional source of uncertainty in the toxicity assessment and risk characterization. Although the provisional RfDs represent the best available numerical estimate of toxicity, there is a significant amount of

uncertainty associated with their use at the Point Lonely installation. The RfDs and SFs are based on studies in mice and rats by the inhalation route of exposure; whereas, in this risk assessment, exposure of humans by the ingestion route only is being evaluated. Furthermore, in the absence of more thorough studies to compare the toxicity of DRPH, GRPH, and RRPH to the toxicity of known refinery streams, it is not clear how well the provisional values represent the toxicity of diesel, gasoline, and residual oils in humans.

In the risk characterization, the assumption was made that the total risk of developing cancer from exposure to site contaminants is the sum of the risk attributed to each individual contaminant. Likewise, the potential for the development of noncancer adverse effects is the sum of the HQs estimated for exposure to each individual contaminant. This approach does not account for the possibility that chemicals act synergistically or antagonistically but probably results in an overestimate of the true risk.

In addition to the more general sources of uncertainty associated with risk assessment methodology, there are site-specific sources of uncertainty. Primarily, these sources are associated with the lifestyle of the native northerners, the time spent on the sites that were investigated during the RI, and specific exposure assumptions (soil ingestion rate, exposure frequency, and exposure duration).

Residents of the North Slope Borough, particularly Nuiqut and Barrow, may use the installation as an access route to traditional hunting and fishing locations (Brewster 1994). No studies have been conducted to measure the time these potential receptors spend on contaminated sites at the installation. Some of the sites with levels of contamination that exceed regulatory benchmarks may not be accessed by this group. Therefore, the assumptions made regarding exposure frequency probably result in an overestimate of the true noncancer hazard and cancer risk.

Similarly, no studies have been conducted to measure the soil ingestion rate of potential receptors on the contaminated sites. Soil ingestion by potential future inhabitants at Point Lonely (assuming a potential residential scenario) may be greater than the default rate of 100 mg/day for adults and 200 mg/day for children. Given the rugged, partially subsistence, lifestyle of this group, it is possible that they incidentally ingest soil at a higher rate than receptors of a similar age in the continental United States. The estimate of soil ingestion rate used in this risk assessment may over- or underestimate the true rate.

The maximum exposure duration assumed for native northerners, 55 years, is probably fairly accurate. The reasonable maximum exposure estimate for inhabitants of the continental United States is 30 years; however, native northerners are more likely to remain in their villages for a longer period. Although, the exposure duration of 55 years is an estimate, it is not expected to significantly over- or underestimate hazard or risk.

2.6 RISK ASSESSMENT SUMMARY AND CONCLUSIONS

The human health risks associated with exposure to contaminated media (soil, sediment, or surface water) at 11 sites at the Point Lonely radar installation were evaluated in this risk assessment. [Note: The Inactive Landfill (LF11) and Vehicle Storage Area (SS14) are co-located and were evaluated in the RI and risk assessment as the Inactive Landfill.] The risk assessment was developed using a three step process:

1) The maximum concentrations of the chemicals detected in each medium (soil, sediment, or surface water) were compared to background concentrations, RBSLs, and ARARs. Chemicals present at concentrations that exceeded their background concentration and either an RBSL or ARAR were retained as COCs for the risk assessment.

2) In the risk characterization, the noncancer HQ, the excess lifetime cancer risk or both were calculated based on the maximum concentration of each COC, and the associated toxicity values developed by EPA.

3) The HQs for each COC at a given site were summed and the sum (called a Hazard Index) was compared to the regulatory benchmark for noncancer hazard: an hazard index of 1.0. Sites where the hazard index exceeded 1.0 were considered to warrant either remediation or further discussion. Sites where the hazard index was less than 1.0 are considered to warrant no further action (EPA 1991c).

   The cancer risks for each carcinogenic COC at a given site were also summed and the sum (the total cancer risk) was compared to the regulatory benchmark for cancer risks: an excess lifetime cancer risk of 1×10^{-6} (one in one million). Sites where the total cancer risk exceeded 1×10^{-6} are considered to warrant either remediation or further discussion. Sites where the total cancer risk was less than 1×10^{-6} are considered to warrant no further action (EPA 1991c).

No Further Action. Based on the human health risk assessment, 6 of the 11 sites at Point Lonely require no further action because the noncancer hazard index for ingestion of soil, sediment, and surface water does not exceed 1.0 and the excess lifetime cancer risk for ingestion of soil, sediment, and surface water is less than 1×10^{-6}. These sites are:

- Beach Diesel Tanks (SS03);
- Old Dump Site (LF07);
- Garage (SS09);
- Diesel Tank (ST10);
- Module Train (SS12); and
- Hangar Pad Area (SS13).

Highly conservative exposure assumptions were applied to the estimation of noncancer hazard and cancer risk and the analytical samples, on which the estimates of hazard and risk are based,

were collected from areas expected to be contaminated. Therefore, it is not likely that any of the six sites noted above pose a threat to human health.

At the five additional Point Lonely sites, the noncancer hazard and the excess lifetime cancer risk associated with the ingestion of soil or sediment is less than 1.0 and 1×10^{-6}, respectively. The noncancer hazard or excess lifetime cancer risk associated with the ingestion of surface water may be a concern at these sites, and they are discussed below.

Sites that Warrant Further Discussion. Based on the noncancer hazard or excess lifetime cancer risk associated with the ingestion of surface water, sites that warrant further discussion include:

- Sewage Disposal Area (SS01);
- Drum Storage Area (ST02);
- POL Storage (SS04);
- Diesel Spills (SS05); and
- Inactive Landfill (LF11)/Vehicle Storage Area (SS14).

Table 2-11 contains a summary of the sites and associated risks that warrant further discussion based on excess cancer risk greater than 1×10^{-6} or the noncancer hazard greater than 1.0.

As noted in the exposure assessment section (Section 2.2), ingestion of surface water at the Point Lonely installation is only a potentially complete pathway if it is assumed that the installation will be deactivated and released for civilian use, and further if it is assumed that surface water within the boundaries of the installation is used as a potable supply. Such a scenario is highly

TABLE 2-11. SUMMARY OF SITES AND MEDIA THAT WARRANT FURTHER DISCUSSION

SITE	MEDIUM	COMMENT
Sewage Disposal Area (SS01)	Surface Water	Benzene and chloromethane in surface water yields cancer risk of 2×10^{-6} for a native northern adult.
Drum Storage Area (ST02)	Surface Water	Benzene in surface water yields cancer risk of 2×10^{-4} for a native northern adult, and 2×10^{-6} for a DEW Line worker.
POL Storage (SS04)	Surface Water	Noncancer hazard is 14 for the native northern adult. Excess lifetime cancer risk is 2×10^{-6} for a DEW Line worker and 2×10^{-3} for a native northern adult.
Diesel Spills (SS05)	Surface Water	GRPH and benzene in surface water yield excess lifetime cancer risk of 2×10^{-6} for a DEW Line worker and 1×10^{-5} for a native northern adult.
Inactive Landfill (LF11)/Vehicle Storage Area (SS14)	Surface Water	GRPH and benzene in surface water yields cancer risk of 5×10^{-6} for the native northern adult receptor group.

unlikely. The installation is currently unmanned, and the nearest settlement is Nuiqsut located approximately 70 miles away. Therefore, there is currently no demand for a potable resource at the installation. Should the installation be released for civilian use in the future, it is very likely that potable water would be obtained from freshwater lakes to the south of the installation, as was the case when the installation was manned. In conclusion, it does not appear that remediation of any site at the Point Lonely installation is warranted on the basis of human health risk.

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3.0 ECOLOGICAL RISK ASSESSMENT

The objective of this ERA is to estimate potential impacts to aquatic and terrestrial plants and animals at the Point Lonely DEW Line installation based on sampling and analyses conducted during the RI of the 11 installation sites (two of the original 12 sites are co-located and were investigated and evaluated as one site). The RI was completed during the summer of 1993 in conjunction with RIs at seven other radar installations.

Guidance documents used during preparation of this assessment include:

- Handbook to Support the Installation Restoration Program Statements of Work (U.S. Air Force 1991);
- Framework for Ecological Risk Assessment (EPA 1992a); and
- Ecological Risk Assessment Guidance for Superfund (EPA 1994).

The approach used to assess potential ecological impacts is conceptually similar to that for human health risks. Potentially exposed populations (receptors) are identified, and then information on exposure and toxicity are combined to derive estimates of risk. The ERA focuses, however, on potential impacts to populations of organisms rather than individual organisms (except in the case of endangered species where individuals are considered). Because ecosystems are composed of a variety of species, ERAs evaluate potential impacts to numerous species.

Ideally, ERAs should evaluate potential risks to communities and ecosystems, as well as to individual populations. Because of the large number of species and communities present in natural systems such ecosystem-wide assessments are very complex and appropriate assessment methodologies have not yet been developed. In addition, dose-response data on community or ecosystem responses generally are lacking. Therefore, evaluations of potential impacts to communities or ecosystems are qualitative.

The degree to which potential ecological impacts can be characterized is highly dependent upon the data available to support such estimates. Such data include: information regarding contaminant release, transport and fate of COC; characteristics of potential receptor population; and adequate supporting toxicity data for the chemicals evaluated.

This ERA is intended to be at a screening level, rather than a full scale investigation of the state of the ecosystem. No site-specific studies of the biota were undertaken. It is based on media sampling (i.e., surface water and soil/sediment samples) and is divided into six sections:

Section 3.1 - Selection of Site Contaminants;
Section 3.2 - Ecological Exposure Assessment;
Section 3.3 - Ecological Toxicity Assessment;
Section 3.4 - Risk Characterization for Ecological Receptors;

Section 3.5 - Ecological Risk Assessment Uncertainty Analysis; and
Section 3.6 - Summary of Ecological Risk.

3.1 SELECTION OF SITE CONTAMINANTS

A stressor in the environment is a chemical, physical, or biological action that can cause a negative impact on an ecosystem (EPA 1992a). Only chemical stressors identified as COCs are evaluated as part of this ERA. A review of the site data indicates that the chemical stressors are primarily petroleum products, solvents, and metals.

COCs are selected based on comparisons of the maximum detected concentrations to background concentrations and action levels [Federal Ambient Water Quality Criteria for surface water (AWQC); ADEC Water Quality Standards (18 AAC 70.020[b]) January 1995; Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota (Suter and Mabrey 1994); ADEC determination of cleanup levels for petroleum contaminated soils; EPA sediment quality criteria (as estimated by Hull and Suter in 1994); and NOAA Sediment Effects Range (Low) (NOAA 1991)]. If no action level was available, the maximum detected concentration of the chemical was compared to a toxicity value derived from acute or chronic exposure tests available in the literature. If the maximum concentration was above this level, the compound was considered a COC. Chemicals present onsite at concentrations in excess of background concentrations and action levels were evaluated for frequency of detection in onsite media. If a chemical was detected at a frequency of less than five percent, it was not considered representative of actual site conditions, and was eliminated from evaluation in the risk assessment. Further, an attempt was made to eliminate elements that were within the range of natural background levels. To that end, if the average concentration (exposure concentration) of a chemical was below the maximum background concentration (i.e., if the average falls within the range of background), and if the maximum detected concentration was less than twice the maximum background concentration (which is meant to approximate the 95 percent UCL of background concentrations), the chemical was not considered a COC. Note that this criterium is used to account for outliers (i.e., hotspots) that are not representative of the distribution and concentration of chemicals to which ecological receptors may be exposed. Tables 3-1 and 3-2 present the data used in the screening process for surface water and soil/sediment. Only chemicals that were detected in at least one environmental sample are presented in these summary tables.

In summary, the decisions for selecting COCs were made using the following logic:

STEP ONE: Is the chemical detected above the maximum detected background concentration?

No: Not considered a COC.
Yes: Continue to step two.

TABLE 3-1. SUMMARY OF CHEMICALS OF CONCERN: SURFACE WATER

CHEMICALS OF CONCERN: POINT LONELY INSTALLATION SURFACE WATER						
CHEMICAL	RANGE OF DETECTED CONCENTRATIONS (µg/L)	BACKGROUND (µg/L) Organics = Pt. Lonely Inorganics = seven arctic DEW Line installations	ACTION LEVEL (µg/L)	FREQUENCY OF DETECTION	AVERAGE CONCENTRATION FOR COC (µg/L)	SELECTED AS COC
ORGANICS						
GRPH	200 - 3,000	<100	---	3/32	140	**YES**
Benzene	1 - 500	<1	5,300[a]	8/32	24	NO
Toluene	0.75 - 1,500	<1	17,500[a]	7/32	66	NO
Ethylbenzene	0.75 - 38	<1	32,000[a]	5/32	2.6	NO
Xylenes (total)	1.5 - 1,600	<2	62,308[b]	8/32	60	NO
Chloromethane	1.4 - 3.5	<1	13,500[d]	2/8	4.1	NO
1,2-Dichloroethane	1.9 - 5	<1	20,000[c]	5/8	5.3	NO
cis-1,2-Dichloroethene	1,020	<1	9,538[b]	1/8	130	NO
Methylene chloride	161	<1	42,667[b]	1/8	21	NO
Naphthalene	0.8	<1	620[b]	1/8	3.6	NO
Tetrachloroethene	1,830	<1	750[b]	1/8	230	**YES**
Trichloroethene	285	<1	7,257[b]	1/8	36	NO
1,3,5-Trimethylbenzene	0.95	<1	---	1/8	3.6	NO
Phenol	27.6	<10.2 - <11	2,560[c]	1/1	27.6	NO
4-Methylphenol	110	<10.2 - <11	125[d]	1/1	110	NO

--- No action level available.
a EPA Ambient Water Quality Criteria (AWQC): Value presented is the Lowest Observed Effect Level (LOEL).
b Based on the Lowest Chronic Value for All Organisms presented in Suter and Mabrey (1994).
c EPA Ambient Water Quality Criteria, Fresh water chronic criteria.
d See text, Section 3.1.1.1, for derivation of action level.

TABLE 3-1. SUMMARY OF CHEMICALS OF CONCERN: SURFACE WATER (CONTINUED)

CHEMICALS OF CONCERN: POINT LONELY INSTALLATION SURFACE WATER						
CHEMICAL	RANGE OF DETECTED CONCENTRATIONS (µg/L)	BACKGROUND (µg/L) Organics = Pt. Lonely Inorganics = seven arctic DEW Line installations	ACTION LEVEL (µg/L)	FREQUENCY OF DETECTION	AVERAGE CONCENTRATION FOR COC (µg/L)	SELECTED AS COC
INORGANICS - based on total metals						
Aluminum	130	<100 - 350	460[b]	1/6	90	NO
Barium	160 - 340	<50 - 93	5,800[b]	5/6	210	NO
Calcium	480 - 97,000	4,500 - 88,000	116,000[b]	6/6	62,000	NO
Iron	380 - 11,000	180 - 2,800	1,000[c]	6/6	3,000	YES
Magnesium	35,000 - 48,000	<5,000 - 53,000	82,000[b]	6/6	43,000	NO
Manganese	55 - 3,100	<50 - 510	1,100[b]	4/6	620	**YES**
Potassium	5,700 - 11,000	<5,000	53,000[b]	4/6	6,600	NO
Sodium	63,000 - 150,000	8,400 - 410,000	680,000[b]	6/6	110,000	NO

--- No action level available.
a EPA Ambient Water Quality Criteria (AWQC): Value presented is the Lowest Observed Effect Level (LOEL).
b Based on the Lowest Chronic Value for All Organisms presented in Suter and Mabrey (1994).
c EPA Ambient Water Quality Criteria, Fresh water chronic criteria.
d See text, Section 3.1.1.1, for derivation of action level.

TABLE 3-2. SUMMARY OF CHEMICALS OF CONCERN: SOILS AND SEDIMENTS

CHEMICALS OF CONCERN: POINT LONELY INSTALLATION SEDIMENT AND SOIL						
CHEMICAL	RANGE OF DETECTED CONCENTRATIONS (mg/kg)	BACKGROUND RANGE (mg/kg)	ACTION LEVEL (mg/kg)	FREQUENCY OF DETECTION	AVERAGE CONCENTRATION FOR COC (mg/kg)	SELECTED AS COC
ORGANICS						
DRPH	62.5 - 14,450	<190 - 150	500[a]	22/101	380	**YES**
GRPH	3.5 - 580	<20 - 27	100[a]	21/81	23	**YES**
RRPH	115 - 5,900	<180 - <670	2,000[a]	9/101	130	**YES**
Benzene	0.05 - 1.6	<0.04 - <0.3	0.052[b]	5/79	0.10	**YES**
Toluene	0.4 - 2	<0.2 - 0.2	0.786[b]	3/79	0.11	NO
Ethylbenzene	0.08 - 2	<0.2 - 0.5	4.36[b]	6/79	0.13	NO
Xylenes (total)	0.1 - 5	<0.04 - 2.0	1.21[b]	9/79	0.28	**YES**
n-Butylbenzene	0.37	<0.3 - 0.22	--	1/6	0.08	NO
p-Isopropyltoluene	0.037	<0.3 - 0.11	--	1/6	0.04	NO
Naphthalene	0.04 - 0.19	<0.3 - 0.21	0.407[b]	3/6	0.09	NO
Styrene	0.08	<0.3 - <0.5	--	1/6	0.07	NO
Tetrachloroethene	0.36 - 6.7	<0.04 - <0.3	2.73[c]	3/40	0.27	**YES**
Trichloroethene	24.0	<0.04 - <0.3	1.07[c]	1/40	6.0	NO
1,2,4-Trimethylbenzene	0.32	<0.05	--	1/1	0.32	NO
1,3,5-Trimethylbenzene	0.50	<0.05	--	1/1	0.50	NO
Tetrachloroethene	0.36-6.7	<0.04-<0.3		3/40		**YES**
Trichloroethene	2.4	<0.04-<0.3	1.07	1/40		NO

-- No action level available.
a ADEC, Interim Guidance for Non-UST Contaminated Soil Cleanup Levels, 17 July 1991.
b EPA Sediment Quality Criteria (estimated using equilibrium partitioning approach in Hull and Suter 1994).
c NOAA 1991, sediment ER-L (Effects Range - low).

TABLE 3-2. SUMMARY OF CHEMICALS OF CONCERN: SOILS AND SEDIMENTS (CONTINUED)

CHEMICALS OF CONCERN: POINT LONELY INSTALLATION SEDIMENT AND SOIL						
CHEMICAL	RANGE OF DETECTED CONCENTRATIONS (mg/kg)	BACKGROUND RANGE (mg/kg)	ACTION LEVEL (mg/kg)	FREQUENCY OF DETECTION	AVERAGE CONCENTRATION FOR COC (mg/kg)	SELECTED AS COC
INORGANICS						
Aluminum	1,950 - 4,300	1,500 - 25,000	--	5/6	1,800	NO
Barium	57 - 110	27 - 390	--	6/6	80	NO
Calcium	38,000 - 130,000	360 - 59,000	--	6/6	61,000	NO
Chromium	3 - 9	<4.3 - 47	81[c]	3/6	11	NO
Copper	3.2 - 12	<2.7 - 45	34[c]	4/6	14	NO
Iron	8,200 - 15,000	5,400 - 35,000	--	6/6	11,000	NO
Magnesium	22,000 - 72,000	360 - 7,400	--	6/6	35,000	NO
Manganese	100.5 - 200	25 - 290	--	6/6	130	NO
Nickel	3.7 - 7	4.2 - 46	21[c]	6/6	5.3	NO
Potassium	355 - 640	<300 - 2,200	--	6/6	440	NO
Sodium	140 - 320	<160 - 680	--	6/6	230	NO
Vanadium	10 - 26	6.3 - 59	--	6/6	18	NO
Zinc	7.5 - 19	9.2 - 95	150[c]	6/6	13	NO

-- No action level available.
a ADEC, Interim Guidance for Non-UST Contaminated Soil Cleanup Levels, 17 July 1991.
b EPA Sediment Quality Criteria (estimated using equilibrium partitioning approach in Hull and Suter 1994).
c NOAA 1991, sediment ER-L (Effects Range - low).

STEP TWO:	Is the chemical detected above the action level or toxicity value?	
	No:	Not considered a COC.
	Yes:	Continue to step three.
STEP THREE:	Is the chemical detected at a frequency greater than five percent?	
	No:	Not considered a COC.
	Yes:	Continue to step four.
STEP FOUR:	Is the average concentration of the chemical greater than the maximum background concentration, and is the maximum detected concentration greater than two times the maximum background concentration?	
	No:	Not considered a COC.
	Yes:	Chemical is classified as a COC.

All data for COCs were averaged (arithmetic mean) according to media. In the case of non-detects, averages were calculated using one-half of the quantitation limits. Replicate and/or duplicate sample results were averaged and treated as one sample. In some cases, non-detects were not considered in the average concentration when no analytes were detected using a particular method. For example, if no VOCs were detected using the 8260 method at a certain site, the non-detects may not have been included in the installation-wide average. Failure to include the non-detects resulted in average concentrations that were more protective of the environment because the inclusion of the non-detects would have lowered the average concentration used to evaluate potential risks. Total metal concentrations were used in determining COCs in surface water. This is a conservative approach because dissolved metal concentrations (the more bioavailable fraction) can be significantly lower than total metal concentrations. Section 3.1.1 describes surface water COCs, and Section 3.1.2 describes soil and sediment COCs. Any exceptions to the selection methodology are discussed in these sections.

3.1.1 Surface Water

Analytical results from the Sewage Disposal Area (SS01), Drum Storage Area (ST02), Beach Diesel Tanks (SS03), POL Storage (SS04), Diesel Spills (SS05), Old Dump Site (LF07), Garage (SS09), Diesel Tank (ST10), Inactive Landfill (LF11)/Vehicle Storage Area (SS14), Module Train (SS12), and Hangar Pad Area (SS13) were compiled and evaluated to identify the COCs. The Vehicle Storage Area (SS14) was co-located with the Inactive Landfill (LF11), and the RI and risk evaluation of the Inactive Landfill include the Vehicle Storage Area.

Surface water samples were collected and analyzed for contaminants likely to be present at the specific sites. Not all samples were analyzed for a "full suite" of parameters, but instead were analyzed for some combination of the following: DRPH, GRPH, RRPH, BTEX, halogenated volatile organic compounds (HVOCs), VOCs, semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), pesticides, and metals. A summary of analytical results for all

sampling conducted at the installation is presented in Appendix G. The following sections present the evaluation of the surface water data. Table 3-1 summarizes the evaluation and selection of COCs in surface water.

3.1.1.1 Organic Compounds. The fifteen organic compounds detected in surface water samples collected from the Point Lonely installation were GRPH, benzene, toluene, ethylbenzene, xylenes (total), chloromethane, 1,2-dichloroethane, cis-1,2-dichloroethene, methylene chloride, naphthalene, tetrachloroethene, trichloroethene, 1,3,5-trimethylbenzene, phenol, and 4-methylphenol. This section presents the evaluation of these compounds as COCs in surface water for the ERA.

GRPH were detected in 3 of 32 surface water samples. The detected concentrations ranged from 200 to 3,000 μg/L. GRPH were not detected in background samples at a detection limit of 100 μg/L. The average concentration of GRPH was 140 μg/L. There is no established action level for GRPH, but GRPH were selected as a COC because the concentrations exceeded the background levels.

Benzene was detected in 8 of 32 surface water samples at concentrations ranging from 1 to 500 μg/L. Benzene was not detected in background samples at a detection limit of 1 μg/L. Although the concentrations exceeded background levels, they were well below the action level of 5,300 μg/L. As a result, benzene was not a COC.

Toluene was detected in 7 of 32 surface water samples at concentrations ranging from 0.75 to 1,500 μg/L. Toluene was not detected in background samples at a detection limit of 1 μg/L. Although the concentrations exceeded background levels, they were well below the action level of 17,500 μg/L. As a result, toluene was not a COC.

Ethylbenzene was detected in 5 of 32 surface water samples at concentrations ranging from 0.75 to 38 μg/L. Ethylbenzene was not detected in background samples at a detection limit of 1 μg/L. Although the concentrations exceeded background levels, they were well below the action level of 32,000 μg/L. As a result, ethylbenzene was not a COC.

Xylenes (total) were detected in 8 of 32 surface water samples at concentrations ranging from 1.5 to 1,600 μg/L. Xylenes were not detected in background samples at a detection limit of 2 μg/L. Although the concentrations exceeded background levels, they were well below the action level of 62,308 μg/L. As a result, xylenes were not a COC.

Chloromethane was detected in two of eight surface water samples at concentrations of 1.4 and 3.5 μg/L. Chloromethane was not detected in background samples at a detection limit of 1 μg/L. An action level for chloromethane was derived from toxicity values in the literature. Dawson et al. (1977 in AQUIRE 1995) report a chloromethane LC_{50} of 270,000 μg/L (the lowest reported) for inland silverside, *Menidia beryllina* (a fish). Using an UF of 20 to convert this to a NOAEL results in an action level of 13,500 μg/L. The maximum detected concentration of 3.5 μg/L is well below the NOAEL, so chloromethane was not a COC.

cis-1,2-Dichloroethene was detected in one of eight surface water samples at a concentration of 1,020 μg/L. cis-1,2-Dichloroethene was not detected in background samples at a detection limit of 1 μg/L. The action level for cis-1,2-dichloroethene is 9,538 μg/L (Suter and Mabrey 1994). Because the detected concentration did not exceed the action level, cis-1,2-dichloroethene was not selected as a COC.

1,2-Dichloroethane was detected in two of eight surface water samples at concentrations ranging from 2 to 4.2 μg/L. 1,2-Dichloroethane was detected in background samples at concentrations of 4.9 to 7.9 μg/L. The concentrations did not exceed background levels and were well below the action level of 20,000 μg/L. As a result, 1,2-dichloroethane was not a COC.

Methylene chloride was detected in one of eight surface water samples at a concentration of 161 μg/L. Methylene chloride was not detected in background samples at a detection limit of 1 μg/L. The action level for methylene chloride is 42,667 μg/L, based on data presented in Suter and Mabrey (1994). The value selected as the action level is the Lowest Chronic Value for All Organisms. Methylene chloride was not selected as a COC because it did not exceed the action level.

Naphthalene was detected in one of eight surface water samples at a concentration of 0.8 μg/L. Naphthalene was not detected in background samples at a detection limit of 1 μg/L. Although the concentrations exceeded background levels, they were below the action level of 620 μg/L. As a result, naphthalene was not a COC.

Tetrachloroethene was detected in one of eight surface water samples at a concentration of 1,830 μg/L. Tetrachloroethene was not detected in background samples at a detection limit of 1 μg/L. Because the detected concentration exceeded background and the action level of 750 μg/L, tetrachloroethene was a COC. The average concentration used in the ERA was 230 μg/L.

Trichloroethene was detected in one of eight surface water samples at a concentration of 285 μg/L. Trichloroethene was not detected in background samples at a detection limit of 1 μg/L. Although the concentrations exceeded background levels, they were below the action level of 7,257 μg/L. As a result, trichloroethene was not a COC.

1,3,5-Trimethylbenzene was detected in one of eight surface water samples at a concentration of 0.95 μg/L. 1,3,5-Trimethylbenzene was not detected in background samples at a detection limit of 1 μg/L. 1,3,5-Trimethylbenzene is an alkylbenzene, a class of chemicals typically found in petroleum products (i.e., DRPH and GRPH) (ATSDR 1993a). 1,3,5-Trimethylbenzene was not selected as a COC because the evaluation of the toxicity of GRPH will conservatively account for the incremental risk associated with 1,3,5-trimethylbenzene.

Phenol was detected in the one surface water sample for which it was analyzed at a concentration of 27.6 μg/L. Phenol was not detected in background samples at detection limits between 10.2 and 11 μg/L. Although the concentrations exceeded background levels, the detected concentration was below the action level of 2,560 μg/L. As a result, phenol was not considered a COC.

4-Methylphenol was detected in the one surface water sample for which it was analyzed at a concentration of 110 μg/L. 4-Methylphenol was not detected in background samples at detection limits between 10.2 and 11 μg/L. An action level for 4-methylphenol was derived from toxicity values in the literature. Kuhn et al. (1988 in AQUIRE 1995) report a 4-methylphenol LC_{50} of 2,500 μg/L for *Daphnia magna*. Using an UF of 20 to convert this to a NOAEL results in an action level of 125 μg/L. The detected concentration of 110 μg/L is below the NOAEL, and as a result, 4-methylphenol was not a COC.

3.1.1.2 Metals. Six surface water samples collected at the Point Lonely installation were analyzed for metals. The eight inorganic analytes detected were aluminum, barium, calcium, iron, magnesium, manganese, potassium, and sodium. Analytes not detected in surface water samples were antimony, arsenic, beryllium, cadmium, chromium, cobalt, copper, lead, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc. This section presents the evaluation of these metals as COCs for the ERA. The background ranges presented are representative of seven arctic coast DEW Line installations. All concentrations of metals discussed below are results from total metal analyses.

It is important to note that, in some cases, sample quantitation limits for certain metals were somewhat higher than ecologically relevant action levels. For example, in the case of copper, the sample quantitation limit was 50 μg/L. However, the current AWQC (based on a hardness value of 100 mg/L $CaCO_3$) for copper is 12 μg/L. As a result, an ecological risk may exist for aquatic organisms from exposure to certain metals at their sample quantitation limits. These metals include aluminum, cadmium, chromium, copper, lead, and selenium. This issue will be addressed further in Section 3.5, Uncertainty Analysis.

Aluminum was detected in one of six surface water samples at a concentration of 130 μg/L. Background concentrations of aluminum ranged from <100 to 350 μg/L. Aluminum was not selected as a COC because it did not exceed the background level.

Barium was detected in five of six surface water samples at concentrations ranging from 160 to 340 μg/L. Background concentrations of barium ranged from <50 to 93 μg/L. The action level for barium is 5,800 μg/L, based on data presented in Suter and Mabrey (1994). The value selected as the action level is the Lowest Chronic Value for All Organisms. Barium was not selected as a COC because it did not exceed the action level.

Calcium was detected in all six surface water samples at concentrations ranging from 480 to 97,000 μg/L. Background concentrations ranged from 4,500 to 88,000 μg/L. The action level is 116,000 μg/L based on the Lowest Chronic Value for All Organisms (Suter and Mabrey 1994). Because calcium did not exceed the action level, it was not selected as a COC.

Iron was detected in all six surface water samples at concentrations ranging from 380 to 11,000 μg/L. Background concentrations ranged from 180 to 2,800 μg/L. Iron concentrations exceeded the background concentration in surface water and the 1,000 μg/L action level, so iron was selected as a COC. The exposure concentration evaluated in this ERA was the average concentration of 3,000 μg/L.

Magnesium was detected in all six surface water samples at concentrations ranging from 35,000 to 48,000 µg/L. Background concentrations ranged from <5,000 to 53,000 µg/L. There is no AWQC for magnesium. The action level is 82,000 µg/L based on the Lowest Chronic Value for All Organisms (Suter and Mabrey 1994). Magnesium was not selected as a COC because it is below the maximum background concentration.

Manganese was detected in four of six surface water samples at concentrations ranging from 55 to 3,100 µg/L. Background concentrations ranged from <50 to 510 µg/L. The action level for manganese is 1,100 µg/L based on the Lowest Chronic Value for All Organisms (Suter and Mabrey 1994). Because the manganese concentration exceeded the background concentration in surface water and the action level, it was selected as a COC. The exposure concentration evaluated in this ERA was the average concentration of 620 µg/L.

Potassium was detected in four of six surface water samples at concentrations ranging from 5,700 to 11,000 µg/L. Potassium was not detected in background samples at a detection limit of 5,000 µg/L. Based on the Lowest Chronic Value for All Organisms (Suter and Mabrey 1994), 53,000 µg/L is the action level. Potassium was not selected as a COC because it did not exceed the action level.

Sodium was detected in all six surface water samples at concentrations ranging from 63,000 to 150,000 µg/L. The background range for sodium was 8,400 to 410,000 µg/L. The action level for sodium of 680,000 µg/L was based on the Lowest Chronic Value for All Organisms (Suter and Mabrey 1994). Because onsite concentrations did not exceed the background level, sodium was not selected as a COC.

3.1.2 Soils and Sediments

Soil/sediment sample analytical results from the 11 sites were compiled and evaluated to determine the COCs. Because ecological receptors are principally exposed to surficial soils, only samples collected from 0 to 1.5 feet were considered in this ERA. Of the 123 soil/sediment samples collected, 101 were collected at or above 1.5 feet in depth. Samples S01-1, S02-1, and S03-1 at the Garage (SS09) were not used in the analysis because they are beneath the Garage structure and one foot below the surface, where ecological receptors are unlikely to be exposed. Not all samples were analyzed for a "full suite" of parameters, but instead were analyzed for some combination of the following: DRPH, GRPH, RRPH, BTEX, HVOCs, VOCs, SVOCs, PCBs, pesticides, and metals. A summary of analytical results for all sampling conducted at the installation is presented in Appendix G. The following sections present the evaluation of the soil/sediment data for the 11 sites. Only compounds that were detected on the sites are discussed. Table 3-2 summarizes the evaluation and selection of COCs in soil and sediment.

3.1.2.1 Petroleum Hydrocarbons. Soil/sediment samples were collected from the sites and selectively analyzed for DRPH, GRPH, and RRPH in 101, 81, and 101 samples, respectively. A discussion of these petroleum hydrocarbon mixtures and their toxicity is presented in Section 3.3.1.

DRPH were detected in 22 of 101 soil/sediment samples at concentrations ranging from 62.5 to 14,450 mg/kg. DRPH analytical results in background samples ranged from non-detects at <65 mg/kg to detects at 180 mg/kg. The action level for DRPH in soils/sediments is 500 mg/kg. Because DRPH were detected at concentrations above the action level, they were selected as a COC. The exposure concentration used in the risk assessment was the average concentration of 380 mg/kg.

GRPH were detected in 21 of 81 soil/sediment samples at concentrations ranging from 3.5 to 580 mg/kg. GRPH analytical results in background samples ranged from non-detects at <20 mg/kg to detects at 27 mg/kg. The action level for GRPH is 100 mg/kg. GRPH were detected at concentrations above the action level, so they were a COC. GRPH in soil/sediment were evaluated in the risk assessment as components of DRPH. Refer to Section 3.3.1 for a discussion of the toxicity of petroleum hydrocarbon mixtures.

RRPH were detected in 9 of 101 soil/sediment samples at concentrations ranging from 115 to 5,900 mg/kg. RRPH were not detected in background samples at detection limits of 180 to 670 mg/kg. The action level for RRPH is 2,000 mg/kg. RRPH were detected at concentrations above the action level in only one sample (5,900 mg/kg in sample S06 at LF07) out of the 101 soil/sediment samples. As a result, they were not considered COCs. The evaluation of DRPH, at an average concentration of 380 mg/kg, will serve as a surrogate for any potential risks posed by RRPH at the one location where it was detected above the action level.

3.1.2.2 Benzene, Toluene, Ethylbenzene, and Xylenes. Seventy-nine soil/sediment samples were collected from the 11 sites at the Point Lonely installation and analyzed for BTEX using the 8020/8020 modified method. Soil/sediment samples were also analyzed for BTEX using the VOC (8260) analysis. Because only six samples were analyzed using the 8260 method, the more comprehensive 8020/8020 modified method analysis was used to evaluate and select the COCs. This is a conservative approach that is expected to be protective of ecological receptors. The following paragraphs summarize the analytical results.

Benzene was detected in 5 of 79 soil/sediment samples at concentrations ranging from 0.05 to 1.6 mg/kg. Benzene was not detected in background samples at detection limits ranging from 0.04 to 0.3 mg/kg. The estimated action level for benzene is 0.052 mg/kg, based on the equilibrium partitioning approach presented in Hull and Suter (1994). Because benzene exceeded the background and action levels, it was selected as a COC. The average concentration used in the ERA was 0.10 mg/kg.

Toluene was detected in 3 of 79 soil/sediment samples at concentrations ranging from 0.4 to 2 mg/kg. Toluene analytical results in background samples ranged from non-detects at <0.2 mg/kg to detects at 0.2 mg/kg. The estimated action level for toluene is 0.786 mg/kg, based on the equilibrium partitioning approach presented in Hull and Suter (1994). Because toluene detection frequency was less than five percent (3.8 percent), toluene was not a COC.

Ethylbenzene was detected in 6 of 79 soil/sediment samples at concentrations ranging from 0.08 to 2 mg/kg. Ethylbenzene analytical results in background samples ranged from non-detects at <0.2 mg/kg to detects at 0.5 mg/kg. The action level is 4.36 mg/kg based on the equilibrium

partitioning approach presented in Hull and Suter (1994). Because concentrations did not exceed action levels, ethylbenzene was not selected as a COC.

Xylenes (total) were detected in 9 of 79 soil/sediment samples. Xylene concentrations ranged from 0.1 to 5 mg/kg. Xylene analytical results in background samples ranged from non-detects at <0.04 mg/kg to detects at 2.0 mg/kg. The action level is 1.21 mg/kg. Xylenes were a COC because concentrations were above action levels. The average concentration used in the ERA was 0.28 mg/kg.

3.1.2.3 Volatile Organic Compounds. Six VOCs were detected in soil/sediment samples using the 8260 method for VOC analysis. The compounds detected were n-butylbenzene, p-isopropyltoluene, naphthalene, styrene, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene. This section presents the evaluation of these compounds as COCs.

n-Butylbenzene was detected in one of six soil/sediment samples at a concentration of 0.37 mg/kg. n-Butylbenzene analytical results in background samples ranged from non-detects at <0.3 mg/kg to detects at 0.22 mg/kg. No action level is available. n-Butylbenzene is an alkylbenzene, a typical constituent of fuel oil (i.e., DRPH) (ATSDR 1993a). n-Butylbenzene was not selected as a COC because the evaluation of the toxicity of DRPH (evaluated at a concentration of 380 mg/kg) will conservatively account for the incremental risk associated with n-butylbenzene.

p-Isopropyltoluene was detected in one of six soil/sediment samples at a concentration of 0.037 mg/kg. p-Isopropyltoluene analytical results in background samples ranged from non-detects at <0.3 mg/kg to detects at 0.11 mg/kg. No action level is available. p-Isopropyltoluene is an alkylbenzene, a typical constituent of fuel oil (i.e., DRPH) (ATSDR 1993a). p-Isopropyltoluene was not selected as a COC because evaluation of the toxicity of DRPH (evaluated at a concentration of 380 mg/kg) will conservatively account for the incremental risk associated with p-isopropyltoluene.

Naphthalene was detected in three of six soil/sediment samples at concentrations ranging from 0.04 to 0.19 mg/kg. Naphthalene analytical results in background samples ranged from non-detects at <0.3 mg/kg to detects at 0.21 mg/kg. The action level is 0.407 mg/kg based on the equilibrium partitioning approach presented in Hull and Suter (1994). Because the concentration did not exceed the action level, naphthalene was not selected as a COC.

Styrene was detected in one of six soil/sediment samples at a concentration of 0.08 mg/kg. Styrene was not detected in background samples at detection limits ranging from 0.3 to 0.5 mg/kg. There is no established action level for styrene. A review of toxicity data indicates NOAELs ranging from 17.5 to 200 mg/kg/day in studies 90 days or longer of rats orally exposed to styrene (ATSDR 1990a). Chronic (561 days) NOAELs for dogs exposed to styrene were reported between 200 and 400 mg/kg/day (ATSDR 1990a). Based on these NOAELs and the estimated ingestion rates for the representative species (Sections 3.2.7.3 and 3.2.7.4), styrene was not selected as a COC.

1,2,4-Trimethylbenzene was detected in three of six soil/sediment samples at concentrations ranging from 0.10 to 0.24 mg/kg. Background sampling results ranged from a non-detect at 0.3 mg/kg to a detection of 0.96 mg/kg. 1,2,4-Trimethylbenzene is classed as an alkylbenzene, which is a typical constituent of fuel oil (i.e., DRPH) (ATSDR 1993a). As a result, 1,2,4-trimethylbenzene was not selected as a COC because it is assumed that the evaluation of the toxicity of DRPH (evaluated at a concentration of 380 mg/kg) will conservatively account for the incremental risk associated with 1,2,4-trimethylbenzene.

1,3,5-Trimethylbenzene was detected in four of six soil/sediment samples at concentrations ranging from 0.07 to 0.78 mg/kg. Background sampling results ranged from a non-detect at 0.3 mg/kg to a detection of 0.41 mg/kg. 1,3,5-Trimethylbenzene is classed as an alkylbenzene, which is a typical constituent of fuel oil (i.e., DRPH) (ATSDR 1993a). As a result, 1,3,5-trimethylbenzene was not selected as a COC because it is assumed that the evaluation of the toxicity of DRPH (evaluated at a concentration of 380 mg/kg) will conservatively account for the incremental risk associated with 1,3,5-trimethylbenzene.

3.1.2.4 Halogenated Volatile Organic Chemicals (HVOCs). Two HVOCs, tetrachloroethene and trichloroethene, were detected in soil/sediment samples analyzed (note: 3 samples at SS09 of the total 43 samples, were not used in the analysis) for HVOCs using the 8010 method. The 8010 analyses were performed at seven of the Point Lonely sites. This section presents the evaluation of these chemicals as COCs in the ERA.

Tetrachloroethene was detected in 3 of 40 soil/sediment samples at concentrations ranging from 0.36 to 6.7 mg/kg. Tetrachloroethene analyses in background samples were non-detects at limits ranging from 0.04 to 0.3 mg/kg. The action level is 2.73 mg/kg, based on the equilibrium partitioning approach presented in Hull and Suter (1994). Because the concentration exceeded the action level, tetrachloroethene was selected as a COC. The average concentration used in the ERA was 0.27 mg/kg.

Trichloroethene was detected in 1 of 40 soil/sediment samples at a concentration of 24 mg/kg. Trichloroethene analyses in background samples were non-detects at limits ranging from 0.04 to 0.3 mg/kg. The action level is 1.07 mg/kg, based on the equilibrium partitioning approach presented in Hull and Suter (1994). Because the frequency of detection was less than five percent, trichloroethene was not selected as a COC.

3.1.2.5 Metals. Thirteen inorganic analytes were detected in six soil/sediment samples collected and analyzed for metals from the Point Lonely installation. The metals detected were aluminum, barium, calcium, chromium, copper, iron, magnesium, manganese, nickel, potassium, sodium, vanadium, and zinc. This section presents the evaluation of these metals as COCs in the ERA.

Aluminum was detected in five of six soil/sediment samples. Concentrations ranged from 1,950 to 4,300 mg/kg. Background concentrations ranged from 1,500 to 25,000 mg/kg. Because aluminum concentrations did not exceed background concentrations, aluminum was not selected as a COC.

Barium was detected in all six soil/sediment samples at concentrations ranging from 57 to 110 mg/kg. The background concentrations of barium ranged from 27 to 390 mg/kg. There is no action level for barium. Because barium concentrations did not exceed background concentrations, barium was not selected as a COC.

Calcium was detected in all six soil/sediment samples analyzed for metals at concentrations ranging from 38,000 to 130,000 mg/kg. Background concentrations ranged from 360 to 59,000 mg/kg. There is no action level for calcium. Because calcium is an essential nutrient and not typically considered a toxic element (it is usually self-regulated by the organism's metabolism), it was not selected as a COC.

Chromium was detected in three of six soil/sediment samples analyzed for metals at concentrations ranging from 3 to 9 mg/kg. The maximum background concentration was 47 mg/kg. The action level for chromium is 81 mg/kg. Because the detected concentrations did not exceed the maximum background level, chromium was not selected as a COC.

Copper was detected in four of six soil/sediment samples analyzed for metals at concentrations ranging from 3.2 to 12 mg/kg. Background concentrations ranged from <2.7 to 45 mg/kg. The action level for copper is 34 mg/kg. Because the detected concentrations did not exceed the maximum background concentration, copper was not selected as a COC.

Iron was detected in all six soil/sediment samples analyzed for metals at concentrations ranging from 8,200 to 15,000 mg/kg. The background concentrations ranged from 5,400 to 35,000 mg/kg. The detected concentrations did not exceed the maximum background concentration, so iron was not selected as a COC.

Magnesium was detected in all six soil/sediment samples analyzed for metals at concentrations ranging from 22,000 to 72,000 mg/kg. The background concentrations for magnesium ranged from 360 to 7,400 mg/kg. There is no action level for magnesium. Because magnesium is an essential nutrient and not typically considered a toxic element (it is usually self-regulated by the organism's metabolism), it was not selected as a COC.

Manganese was detected in all six soil/sediment samples analyzed for metals at concentrations ranging from 100.5 to 200 mg/kg. The background concentrations for manganese ranged from 25 to 290 mg/kg. There are no action levels for manganese. Because concentrations did not exceed background concentrations, manganese was not selected as a COC.

Nickel was detected in all six soil/sediment samples analyzed for metals at concentrations ranging from 3.7 to 7 mg/kg. The background concentrations ranged from 4.2 to 46 mg/kg. The action level for nickel is 21 mg/kg. Nickel was not selected as a COC because its concentrations did not exceed the maximum background level.

Potassium was detected in all six soil/sediment samples analyzed for metals at concentrations ranging from 355 to 640 mg/kg. The background concentrations ranged from <300 to 2,200 mg/kg. There is no action level for potassium. Potassium was not selected as a COC because the concentrations were below the maximum background concentration.

Sodium was detected in all six soil/sediment samples analyzed for metals at concentrations ranging from 140 to 320 mg/kg. These concentrations did not exceed the maximum background concentration of 680 mg/kg. There is no action level for sodium. Because the detected concentration of sodium did not exceed the maximum background concentration, it was not selected as a COC.

Vanadium was detected in all six soil/sediment samples analyzed for metals at concentrations ranging from 10 to 26 mg/kg. The background concentrations ranged from 6.3 to 59 mg/kg. There is no action level for vanadium. Vanadium was not selected as a COC because its concentrations were below the maximum background concentration.

Zinc was detected in all six soil/sediment samples analyzed for metals at concentrations ranging from 7.5 to 19 mg/kg. The background concentrations for zinc ranged from 9.2 to 95 mg/kg. The action level for zinc is 150 mg/kg. Zinc was not selected as a COC because the concentrations were below the maximum background concentration.

3.2 ECOLOGICAL EXPOSURE ASSESSMENT

The vegetation of the Arctic Coastal Plain and the ecosystems it characterizes have developed primarily as a result of the low relief and harsh environment. The growing season is short, typically extending from June through mid-September. Winters are long, cold, dry, and dark. Air temperatures that average below freezing for most of the year result in a permafrost layer that begins near the surface and reaches to depths as great as 610 meters. Seasonal thawing results in an active layer between ground surface and 3.7 meters below the surface (Hart Crowser 1987).

The impervious permafrost layer prevents percolation and infiltration of water below the active layer, and the generally flat terrain provides poor drainage. As a result, the ecosystems of the Arctic Coastal Plain are often defined not only by their plant associations but also by the degree of water found in and on them. Hart Crowser (1987) describes five major ecosystems for the classification of tundra and Arctic Coastal Plain communities:

- Marine zones: these include lagoons, estuaries, barrier islands, strands, and beaches. The abundance of vegetation along the marine coastal zone is inversely related to the amount of beach scouring by waves and ice. Mainland beaches support a variety of vegetation including sedges, grasses, and forbs.

- Wet sedge meadows: an association of meadows, ponds, and lakes also known as "wet tundra". This system, with its associated wetlands, is dominant in the area extending west from the Colville River to the Chukchi Sea (including the Point Lonely, Point Barrow, Wainwright, Point Lay, and Cape Lisburne installations). Differences in vegetation within this ecosystem are related to moisture and microrelief.

- Tussock tundra: "moist tundra" consisting primarily of areas dominated by tussock-forming cottongrass. This system covers significant portions of the Arctic Coastal Plain.

- Riverine systems and floodplains: including riparian shrubland on recent and old alluvium. Being better drained than surrounding lands, the riparian environment supports a distinctive "shrub thicket" vegetation.

- Alpine tundra: including rocky upland areas of sparse mat-forming or fell-field vegetation.

The species associated with each ecosystem at the Point Lonely DEW Line installation have the potential to be exposed to COCs if exposure pathways are complete. If pathways are complete, the representative species selected are considered receptors. Figure 3-1, Section 3.2.3, presents a schematic model of the potential exposure pathways.

The ecological exposure assessment segment of the risk assessment contains the following: the most common species found at the DEW Line installations in Section 3.2.1; the representative species and the rationale used for their selection in Section 3.2.2; a discussion of the exposure pathways in Section 3.2.3; and a review of the habitat suitability for representative species in Section 3.2.4. Sections 3.2.5, 3.2.6, and 3.2.7 provide the methodology of the exposure assessment for representative plants, aquatic species, and birds and mammals, respectively. Life history tables, which provide species-specific information for use in the exposure assessment, are included in Section 3.2.7.

3.2.1 Species of the Arctic Coastal Plain

The representative species used in the ERA for the Point Lonely installation were selected from species characteristic of the DEW Line installations along the Arctic Coastal Plain and are detailed in Sections 3.2.2.1 through 3.2.2.5.

The Point Lonely installation is located along the northern boundary of the Arctic Coastal Plain. Hart Crowser (1987) and Woodward-Clyde (1993) have listed the species likely to occur along the coastal plain based on site-specific studies and a review of the literature. The marine zone, wet sedge meadows, tussock tundra, and riverine/riparian are the primary ecosystems found at the Point Lonely installation. Alpine tundra is minimal at the site and is not evaluated further. Site-specific surveys of the ecosystems associated with the DEW Line installations have not been conducted for this risk assessment; however, a study investigating the abundance and distribution of Steller's and spectacled eiders was used (Alaska Biological Research 1994).

3.2.1.1 Plants. Plants commonly associated with the marine zone are sedges, grasses, and forbs. *Carex subspathacea* and *C. aquatilis* are dominant plants in the coastal wetlands. The wet sedge meadow (also known as "wet tundra") is characterized by a variety of sedges and grasses. Typical species include cottongrass, *Eriophorum* spp.; tundra grass, *Dupontia fischeri*; and mosses, *Sphagnum* spp. Marsh marigold, *Caltha palustris* and horsetail, *Equisetum* spp. may be found in wetter areas (Hart Crowser 1987).

The tussock tundra (or moist tundra) is drier than the wet sedge meadow/wet tundra association. Tussock-forming cottongrass is the dominant plant species. Grasses, sedges, dwarf shrubs, mosses, and lichens are scattered throughout the tussock complex. These species include willows, *Salix* spp.; Labrador tea, *Ledum palustri*; blueberry and lingonberry, *Vaccinium* spp.; and lousewort, *Pedicularis* spp. (NPRA Task Force 1978; Bergman et al. 1977).

Riverine/riparian systems are composed of a diversity of habitat types and species. The dominant plants here are low-growing shrubs with a scattered understory of grasses and herbs. Larkspur, *Delphinum brachycentrum*; cinquefoil, *Potentilla* spp.; bearberry, *Arctostaphylos* spp.; and wormword, *Artemesia arctica*, are common species (NPRA Task Force 1978; Bergman et al. 1977).

3.2.1.2 Aquatic Organisms. Sixty-six species of fish inhabiting marine, estuarine, and freshwater systems have been identified in the arctic region (Hart Crowser 1987). Marine species inhabiting the nearshore and offshore waters include boreal smelt, *Osmerus eperlanus*; Pacific herring, *Clupea harengus*; arctic cod, *Boreogagus saida*; and fourhorn sculpin, *Myoxocephalus quadricornis*. Anadromous species using arctic rivers for spawning include the arctic cisco, *Coregonus autumnalis*; arctic char, *Salvelinus alpinus*; and occasional pink and chum salmon, *Oncorhynchus* spp. Lack of overwintering habitat is a significant limiting condition for both anadromous and freshwater fish of the arctic region. The principal freshwater fish found in the region are grayling, *Thymallus arcticus*; lake trout, *Salvelinus namaycush*; burbot, *Lota lota*; and nine-spined stickleback, *Pungitius pungitius* (Hart Crowser 1987).

Invertebrates that may be present in the waters and wet habitats of the Arctic Coastal Plain are well represented by the crustaceans (i.e., copepods, isopods, amphipods, and decapods).

3.2.1.3 Birds. There are approximately 180 species of birds seasonally associated with the habitats of the Arctic Coastal Plain. Of these, many are shorebirds and waterfowl using migratory corridors that pass through the Point Lonely area. Bird use of the coastal plain is highly seasonal and associated with typical avian breeding and migration cycles. Shoreline habitats are used significantly in association with molting, pre-migratory staging, and post breeding movement. These habitats are considered critical by the U.S. Fish and Wildlife Service (USFWS 1982). Principal species include glaucous gull, *Larus hyperboreus*; red phalarope, *Phalaropus fulicaria*; dunlin, *Calidris alpina*; loons, *Gavia* spp.; sandpipers, *Calidris* spp.; eiders, *Somateria* spp.; and geese, *Branta* spp. and *Chen* sp. Among the migratory passerine species using the coastal habitats are the Savannah sparrow, *Passerculus sandwichensis*; common and hoary redpolls, *Carduelis* spp.; snow bunting, *Plectrophenax nivalis*; and Lapland longspur, *Calcarius lapponicus* (Woodward-Clyde 1993).

3.2.1.4 Mammals. The mammalian fauna of the Arctic Coastal Plain and adjacent waters is relatively simple compared to fauna at lower latitudes. A review of species lists indicates a total of 38 species that commonly occur in the arctic; 11 of these are marine mammals (Hart Crowser 1987). A sampling of the terrestrial mammals geographically associated with the DEW Line stations, including Point Lonely, consists of brown lemming, *Lemmus trimucronatus*; masked shrew, *Sorex cinereus*; arctic fox, *Alopex lagopus*; red fox, *Vulpes vulpes*; weasels, *Mustela* spp.;

tundra vole, *Microtus oeconomus*; caribou, *Rangifer tarandus*; and grizzly bear, *Ursus arctos* (Hart Crowser 1987; Woodward-Clyde 1993).

Marine mammals of the arctic coast include polar bear, *Ursus maritimus*; walrus, *Odobenus rosmarus;* six species of whales; and five species of seals. The most common of the whale and seal species are beluga, *Delphinapterus leucas*; bowhead whale, *Balaena mysticetus*; gray whale, *Eschrichtius robustus*; ringed seal, *Phoca hispida*; and bearded seal, *Erignathus barbatus* (Hensel et al. 1984).

3.2.1.5 Threatened and Endangered Species. Species of the Arctic Coastal Plain and nearby waters that are protected by federal and state designations include bowhead whale (endangered); fin whale, *Balaenoptera physalus* (endangered); sei whale, *Balaenoptera borealis* (endangered); and humpback whale, *Megaptera novaengliae* (endangered). The gray whale was delisted by the National Marine Fisheries Service on 16 June 1994. Avian species include the spectacled eider, *Somateria fischeri* (threatened) and Steller's eider, *Polysticta stelleri* (candidate for listing). Based on the latest federal and state lists of threatened and endangered plant species (June 1995), no plant species at the DEW Line installations are currently listed as threatened or endangered.

3.2.2 Representative Species

It is impractical to evaluate all of these potential receptors individually because of the great diversity of plants and animals at a given site. Thus, for ERAs, a set of "representative species" is selected for further evaluation. The representative species are selected primarily on the species' likelihood of exposure given their preferred habitat, feeding habits, and distribution of contaminants. Potential exposure pathways are shown in Figure 3-1 and discussed in Section 3.2.3. The abundance of a species relative to the areal extent of the sites is also considered. The representative species encompass a range of ecological niches in order to achieve the best characterization of the ecosystems being examined. In addition, species are selected, in part, as a result of the availability of toxicity, exposure, and life history information. Species that may be sensitive to environmental impacts, such as endangered or threatened species, are also evaluated. Any endangered or threatened species discussed in the ERA are not considered representative of the Arctic Coastal Plain or the Air Force arctic radar installations. These species are evaluated to provide information about whether they face potential risks from exposure to the COCs being evaluated in the ERA.

For the DEW Line stations, the groups of receptors evaluated include plants, aquatic invertebrates, fish, birds, and mammals. Potential risks to representative species are estimated by evaluating sampling data for the relevant exposure media (i.e., soil, sediments, and surface water). For plants, soil/sediment COC data are used to estimate potential uptake. For aquatic species, surface water COC concentrations are used to estimate exposure, and for birds and mammals, exposures are estimated by evaluating their potential dietary intakes of COCs. No site-specific studies were conducted to determine exposure or toxicity levels at the installation.

The similarity of ecosystems at each of the arctic coastal DEW Line installations allows the use of the same set of representative species for all installations. It may be possible that a

representative species inhabits the general area of an installation, but does not occur specifically on the installation property. When and if this situation occurs, it will be noted. The receptors selected as representative species for the Point Lonely installation are listed in the paragraphs that discuss the representative groups (i.e., plants, aquatic organisms, birds, mammals, and threatened or endangered species). Table 3-3 presents the representative and sensitive species for arctic coastal DEW Line installations, including endangered and threatened species that potentially may be exposed. The USFWS was consulted about the occurrence and selection of threatened and endangered species.

3.2.2.1 Representative Plants. Plants selected as representative species are sedges, willows, cottongrass, and various berry-bearing plants *Vaccinium* spp. These species were selected because they are abundant on all the sites, are important links in the trophic structure of the ecosystems of the arctic, and represent a major percentage of the primary production along the coastal plain. The blueberry, huckleberry, and lingonberry, *Vaccinium* spp., are also evaluated because of their roles as forage plants and as subsistence species. All of these representative species are evaluated at the Point Lonely installation.

3.2.2.2 Representative Aquatic Invertebrates and Fishes. The invertebrates selected as representative species are *Daphnia* spp. (water fleas). The nine-spined stickleback is the representative fish species. The arctic char is not evaluated at the Point Lonely installation because it is unlikely that the exposure pathways are complete. *Daphnia* spp. are abundant and represent a portion of the diet of the selected fish species (Johnson and Burns 1984; Wootton 1976), and toxicity information is readily available for them. The nine-spined stickleback is a freshwater species that also uses brackish habitats, nests in aquatic vegetation, and is prey for other fish and bird species (Wootton 1976). No marine mammals are evaluated in the Point Lonely ERA because there are no complete pathways for COCs (at concentrations that are of concern) to reach potential marine receptors.

3.2.2.3 Representative Birds. The representative avian species are Lapland longspur; brant, *Branta bernicla*; glaucous gull; and pectoral sandpiper, *Calidris melanotos*. The Lapland longspur is a passerine belonging to a terrestrial feeding guild (including sandpipers, turnstones, and phalaropes) (Custer and Pitelka 1978). The longspur's diet of insects and seeds (Custer and Pitelka 1978) makes it an important link in the arctic trophic web. The brant nests and molts among the numerous ponds in the tussock tundra and grazes on sedges and cottongrass (Palmer 1976). It is considered to be an important subsistence resource. The glaucous gull is a predatory scavenger that feeds on small mammals, young birds, carrion, and garbage, and breeds along the Arctic Coastal Plain (Farrand 1983). The pectoral sandpiper is an abundant shorebird that is primarily insectivorous and breeds on the Arctic Coastal Plain. The Lapland longspur, brant, glaucous gull, and pectoral sandpiper are in potential exposure pathways at the Point Lonely installation and are evaluated in this ERA. All the avian species in this ERA are migratory, and as such, are protected under the Migratory Bird Treaty Act of 1978. This is reflected by the use of a protected species factor of 2 in the calculation of avian toxicity reference values.

3.2.2.4 Representative Mammals. The representative species of mammals are the brown lemming, arctic fox, and barren-ground caribou. The brown lemming is the predominant

TABLE 3-3. REPRESENTATIVE AND SENSITIVE SPECIES AT THE ARCTIC DEW LINE INSTALLATION SITES

COMMON NAME	GENUS AND SPECIES
PLANTS	
Sedge	*Carex* spp.
Cottongrass	*Eriophorum* spp.
Willow	*Salix* spp.
Berries	*Vaccinium* spp.
AQUATIC ORGANISMS	
Water fleas	*Daphnia* spp.
Nine-spined stickleback	*Pungitius pungitius*
Arctic char	*Salvelinus alpinus*
BIRDS	
Lapland longspur	*Calcarius lapponicus*
Brant	*Branta bernicla*
Glaucous gull	*Larus hyperboreus*
Pectoral sandpiper	*Calidris melanotos*
MAMMALS	
Brown lemming	*Lemmus trimucronatus*
Arctic fox	*Alopex lagopus*
Barren-ground caribou	*Rangifer tarandus*
ENDANGERED AND THREATENED SPECIES*	
Spectacled eider[b]	*Somateria fischeri*
Steller's eider[c]	*Polysticta stelleri*

* See Section 3.2.2.5 for information about endangered and threatened species.

a These representative species were selected for seven DEW Line installations (Barter Island, Bullen Point, Oliktok Point, Point Lonely, Point Barrow, Wainwright, and Point Lay) and the Cape Lisburne radar installation.

b Threatened status.

c Candidate for threatened status, see text for explanation.

small mammal at all the coastal arctic DEW Line installations. The lemming consumes more vegetation than expected for an animal its size, due to its low assimilation efficiency, the low nutrient value of winter forage, and the high metabolic demands of the arctic environment (Chappell 1980). The arctic fox is selected as a representative species because it is ubiquitous along the coastal plain, and its carnivorous diet (mostly lemmings) places it near the top of the trophic structure in the arctic. Eberhardt et al. (1982) note that in fall and winter, and to a lesser extent in summer, the arctic fox frequently uses areas near development. This tendency may expose the fox to pathways of contamination. Additionally, the fox, a relatively common furbearer, can be an important subsistence resource. The caribou is selected as a representative species because it uses areas on, or near, a number of the radar installations during migration, calving, and post-calving. In addition, the caribou is a significant subsistence resource for local people along the Arctic Coastal Plain (USFWS 1982; Cuccarese et al. 1984; Hensel et al. 1984). The three mammal species discussed may be exposed to COCs at the Point Lonely installation and are evaluated in this ERA.

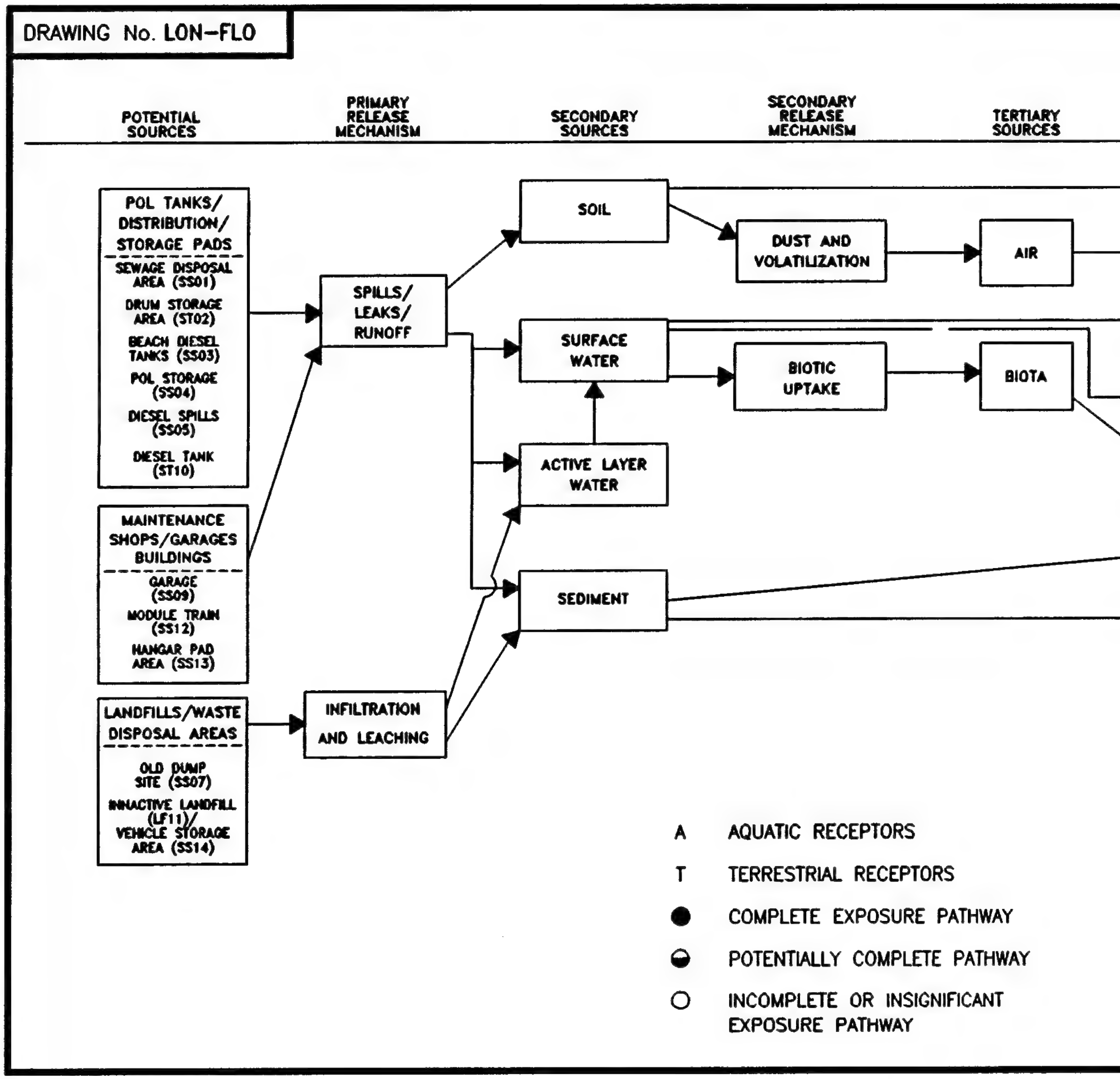
3.2.2.5 Threatened and Endangered Species. The threatened and endangered species that potentially occur at the DEW Line installations are the spectacled eider and Steller's eider. The spectacled eider is federally listed as threatened, and Steller's eider is a candidate for listing as threatened. The U.S. Fish and Wildlife Service indicated that it was likely that Steller's eider would be listed as threatened sometime in 1995 (Ambrose 1994 pers. comm.), but a federal moratorium on additions to the threatened and endangered lists is in effect. Alaska Biological Research (1994) conducted surveys searching for spectacled and Steller's eiders on and near the DEW Line installations. The surveys report both species present either on, or in the vicinity of, the Point Lonely installation. The spectacled eider will be evaluated in this ERA. Because of the ecological similarity of spectacled and Steller's eiders (i.e., relatively similar morphology, physiology, niche, and trophic status), the evaluation of the spectacled eider will serve as a surrogate risk indicator for Steller's eiders in the event that the Steller's eiders are exposed to COCs at the Point Lonely installation. The arctic peregrine falcon, *Falco peregrinus tundrius*, was delisted by the USFWS on 5 October 1994.

3.2.3 Exposure Pathways

This section discusses potential exposure pathways for ecological receptors. In addition, methods used to quantify exposures to selected species of plants, aquatic organisms, birds, and mammals are presented. Quantitative estimates of exposure will be compared with TRVs derived in Section 3.3 to estimate risks in the risk characterization section (Section 3.4).

Ecological receptors can be exposed to COCs through abiotic and biotic media. Potential exposure pathways for terrestrial and aquatic organisms are summarized in Figure 3-1. The following sections describe the potential exposure routes and a determination of pathways evaluated in the risk assessment.

Potential risks to representative species of plants from exposure to COCs in soil and surface water will be addressed. The most significant route of exposure for plants is direct contact with soil at the site, although a qualitative evaluation of the effects of COCs in surface water is presented in Section 3.4.1.



POINT LONELY RADAR INSTALLATION

USAF 611th CES

FIGURE NO. 3-1

ECOLOGICAL RISK ASSESSMENT POTENTIAL EXPOSURE PATHWAYS

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Aquatic organisms such as fishes and invertebrates are primarily exposed through direct contact with surface water. Surface water is in direct contact with dermal surfaces as well as gills and other respiratory structures. Fishes and invertebrates also may be exposed to COCs through ingestion of plant and animal items in the diet, direct contact with sediments, and incidental ingestion of sediments while foraging. Direct contact with surface water is the primary exposure route; therefore, these secondary routes (ingestion and direct contact with sediment) will not be evaluated for aquatic organisms.

Birds and mammals may be exposed to COCs through a variety of pathways including ingestion of surface water used for drinking, ingestion of plant and animal diet items, and incidental ingestion of surface soils and sediments while foraging. Wildlife species are not expected to be exposed to COCs via inhalation because the surface soils are well vegetated and moist during the growing season and frozen and/or snow covered the remainder of the year. Therefore, this pathway is not evaluated in the ERA.

There is insufficient toxicity and exposure information available for the representative species to allow quantification of exposures from dermal contact with soil or sediments; therefore, these pathways were not quantitatively evaluated. Because soils and sediments represent potential pathways, total exposures for the representative species could be underestimated. This represents one of the uncertainties discussed in Section 3.5 of this risk assessment.

The soil and sediment samples at the Point Lonely installation are taken at depths ranging from the surface to four feet deep. Only samples at depths of 1.5 feet or less were used in the ERA because the potential exposure pathways for the representative species are likely to be incomplete at depths greater than 1.5 feet. [As noted earlier in Section 3.1.2, exceptions to this guideline were three samples collected at a depth of one foot below the Garage (SS09)]. It is unlikely that any of the representative species would be exposed to soil or sediments much below one foot, although the brown lemming is reported to burrow up to one foot deep (Nowak 1991).

3.2.4 Habitat Suitability for Representative Species

In order to assess the representative species' degree of exposure to the COCs, the habitat suitability of each of the 11 sites was evaluated. The habitat suitability evaluation considered the representative aquatic, avian, and mammalian species at the Point Lonely installation.

Human development and activities at the Point Lonely installation have impacted the natural habitats available to the representative species. The effects of these impacts are uncertain; in some cases the activities probably deter wildlife use of the area and in other cases they may attract wildlife (e.g., arctic fox and gulls attracted to a landfill). Although these impacts may affect how and when representative species may use the habitats at Point Lonely, the impacts are not subject to quantification, and as a result, all the sites at the Point Lonely installation are evaluated in this ERA. In some cases, the media-specific samples have been taken at locations that do not represent suitable habitat for all the representative species (e.g., under-building sample locations that are obviously not suitable for caribou, or surface water sample locations that are not suitable for fish species). This may result in an overestimation of exposure because sample data from

all locations are used to calculate the average concentrations which, in turn, are used to estimate exposure for the representative species. These conditions will be noted in the risk characterization and uncertainty discussions (Sections 3.4 and 3.5, respectively).

The ERA is being conducted for the entire Point Lonely installation, but only a portion of the facility consists of potentially contaminated sites. The sites are estimated to total approximately 7.5 hectares (ha), or 18.5 acres, based on site maps. The spatial extent of the sites is considered when estimating the onsite dietary intake (IS) in Section 3.2.7.2. In general, based on professional judgement and onsite observations but not on site-specific surveys, the installation provides habitat less suitable than nearby areas because of the numerous roads, gravel pads, and overall development.

3.2.5 Exposure Assessment for Representative Species of Plants

The harsh environment of the Arctic Coastal Plain imposes many restrictions on plant life. The presence of permafrost limits infiltration and percolation of water, so the water table is often at or near the surface. Most plant species are perennial, with much of their biomass (50 to 98 percent) underground (Raven et al. 1986). The potential pathways of contamination for plants are through the soil/sediment and surface water.

Carex spp., *Salix* spp., and *Eriophorum* spp. all store food reserves in rhizomes. Mychorrhizal fungi play an important role in the transport and delivery of nutrients to the rhizomes and the roots of these species. This underground system probably developed in response to the harsh aboveground arctic environment. Surface water contaminated with chemicals that are lighter than water (i.e., petroleum and its derivatives) does not present a greatly increased hazard to the below-ground portion of plants. This has been shown experimentally by exposing arctic coast vegetation to petroleum products (Walker et al. 1978). The experiments showed that sedges, willows, and cottongrass plants were not adversely affected by low to moderate amounts of petroleum (spill concentrations in the studies were up to 12 L/m^2) in wet environments. Thus, soil/sediment will be considered the primary pathway of potential contamination for plants. The chemical concentration used in the risk characterization (Section 3.4) is the average concentration of the COC in the soil/sediments at the installation. A qualitative evaluation of the effect of potentially contaminated surface water on plants is presented in Section 3.4.1.

3.2.6 Exposure Assessment for Representative Aquatic Organisms

Organisms that dwell in an aquatic environment are exposed to chemicals contained in the water column. For this reason, the exposure assessment considers the concentrations in surface water to be the exposure concentrations for aquatic organisms. As described in Section 3.2.3, the primary exposure route for aquatic organisms is direct contact with surface water. As a result, the aquatic representative species are not evaluated for contact with, or ingestion of, sediments. The risk assessment compares the average concentration of the COCs found in surface waters to toxicity data for the representative aquatic species to calculate the risk estimate.

3.2.7 Exposure Estimates for Representative Bird and Mammal Species

Exposure estimates for representative species of mammals and birds (expressed as a unit of chemical ingested per unit of body weight) are based on their total exposure to COCs from diet, soils, and surface water using the following equation:

$$EE = [(FI \times CF) + (WI \times CW) + (SI \times CS \times ROA)] \times UCF \times IS / BW$$

where:

EE	=	estimated exposure (mg/kg-bw/day).
FI	=	food intake rate (g/day); rates are derived in the life history tables. Diets (both vegetable and animal components) are proportioned according to the diet composition information in the life history tables and are presented below.
CF	=	chemical concentration in food (mg/kg); based on concentrations for each group of food items.
WI	=	water intake rate (L/day); rates are derived in the life history tables.
CW	=	chemical concentration in water (μg/L); see Section 3.1 for calculations of concentrations.
SI	=	soil/sediment intake rate (g/day); based on a percentage of food intake.
CS	=	chemical concentration in soil/sediment (mg/kg); see Section 3.1 for calculations of concentrations.
ROA	=	relative oral availability; default to 1.0 (lack of information). This value assumes that the bioavailability of the chemical in the test medium is the same as for the medium onsite.
UCF	=	0.001; unit conversion factor used in conversion of g to kg, μg to mg, and L to ml, to ensure EE is reported in mg/kg-bw/day.
IS	=	fraction of dietary intake at potentially contaminated sites (by weight).
BW	=	body weight (kg).

In the case of species that have partial herbivorous dietary intakes, the CF x FI phrase in the equation is multiplied by the proportion of vegetation in their diet (these calculations are presented in Appendix C, Bioconcentration Factor Calculation, and Appendix D, Concentration in Food Calculations). Those species and their respective proportions are: Lapland longspur, 0.25; brant, 0.90; glaucous gull, 0.10; pectoral sandpiper, 0.10; and spectacled eider, 0.25 (see the life history tables for references regarding the proportion of vegetation in the species' diets). The estimated exposure calculations for bird and mammal receptors are presented in Appendix E.

3.2.7.1 Potential Bioaccumulation of COCs in Representative Species. The potential risks from ingestion of COCs in dietary items are difficult to determine because of the complexity of the trophic web. Inputs to the exposure estimate equation include concentrations of contaminants in water and soil, ingestion rates for water, food, and soil, the relative use of the potentially contaminated sites compared to the representative species' normal range, and body weight. The food ingested, in the case of higher level consumers, may be from different levels of the trophic web. For example, a contaminant may be taken up by a plant that is consumed

by a lemming, which is then eaten by an arctic fox. The amount of contaminant to which the fox is exposed is not readily quantified without supporting empirical data at each trophic level. Because data is lacking to assist in quantifying bioaccumulation, the risk assessment does not account for bioaccumulation in the animal portion of the trophic web. This uncertainty is tempered by the "hot spot" nature of the distribution of the COCs. It is possible that representative species may be exposed to these "hot spots" occasionally, but it is unlikely that their entire exposure will occur at these locations. Use of the average concentrations to estimate exposure may overestimate the potential exposure of representative species (this is discussed in more detail in the ERA Uncertainty Analysis, Section 3.5.1). Furthermore, the likelihood of predators repeatedly taking prey that were exposed to a COC "hot spot" is low. For example, the arctic fox ranges over such a wide area that any COCs to which the fox would be exposed via bioaccumulation would represent only a very small proportion of its overall exposure.

Further, most of the COCs in soils/sediments at the Point Lonely installation are organic compounds unlikely to bioaccumulate. For illustrative purposes, bioconcentration factors (BCF) calculated (Veith et al. 1979 in Spacie and Hamelink 1985) for the organic COCs are presented in Table 3-4. The exposure estimates for organic chemicals do not include potential bioaccumulation of COCs in the animal portion of the trophic web. It is unlikely that the organic chemicals will bioaccumulate (based on the concentrations reported in the soil/sediment and water) such that the exposure estimates would exceed, or even approach, the TRVs.

The inorganic COCs at Point Lonely are iron and manganese in surface water. The bioaccumulation of metals in the animal portion of the trophic web is not amenable to quantification without sample concentrations at each level of consumer. The following qualitative discussions address the potential bioaccumulation of the inorganic COCs at the Point Lonely installation.

Iron. Information about the bioaccumulation of iron is not available in the literature, but it is likely that metabolic processes will prevent undue bioaccumulation because iron is an essential nutrient.

TABLE 3-4. BIOCONCENTRATION FACTORS FOR SELECTED ORGANIC COMPOUNDS IN WATER

CHEMICAL	Log K_{ow}	BCF
Benzene	2.13	25
Tetrachloroethene	2.53	49
Xylene	3.16	149

Note: BCF calculated from Log K_{ow} according to the following equation:
Log BCF = 0.76 Log K_{ow} - 0.23 (Veith et al. 1979 in Spacie and Hamelink 1985)
K_{ow} = octanol/water partition coefficient

Manganese. Manganese is an essential nutrient (ATSDR 1990b). It is not likely that the concentrations of manganese found at the Point Lonely installation would bioaccumulate because this mineral is regulated for metabolic use by the representative species.

3.2.7.2 Estimation of Percent Ingested Onsite. The size of the areas used by the representative species, and hence their potential exposure to COCs, varies greatly. Generally, a species' home range is used to characterize the size of the area it uses on a regular basis (disregarding migration and dispersal). When home range information for a species was not available, population density values were used to estimate the area used by the species. This information, combined with the extent of the potentially contaminated sites, can be used to estimate the percent of dietary intake that a species gets from the sites.

This estimate is referred to as the "percent of dietary intake at sites" (IS) value in the exposure estimate equation. The IS value is represented by the ratio of the total area of the sites (7.5 ha or 18.5 acres) to the reported home range size (or converted population density values) for the representative species. The representative species are most likely to be at Point Lonely during, or directly after, the breeding season, when many species become territorial. These territories represent the area used by the species. The densities of the population may provide estimates of the size of the territories and are used as substitute values when home range information is unavailable. This presents an added degree of uncertainty (see Section 3.5.3). If the home range (or converted population density value) is less than the total areal extent of the sites (7.5 ha), the maximum value for IS is 1.0 because it is possible that a species could meet all its dietary intake needs within the potentially contaminated areas. The IS values for the representative bird and mammal species are given below. Note that these are conservative estimates because the 7.5 ha size assumes that the contaminated sites are the only areas used. Obviously, the species would use the suitable areas between the potentially contaminated sites, resulting in lower potential exposure to COCs than if the species restricted its location to contaminated sites only.

Birds. Lapland longspur. IS = 0.5; Derksen et al. (1981) report a breeding density of 38.6 birds/km^2. This corresponds to about one bird/2.6 ha. Potentially, the longspur could meet all of its dietary demands within the potentially contaminated sites. Nevertheless, an IS value of 0.5 is used because the longspur prefers drier upland habitat and shrublike vegetation instead of the wetter areas and unvegetated gravel pads where the majority of contaminant pathways occur.

Brant. IS = 0.38; density of breeding pairs reported by Derksen et al. (1981) is 5.0 birds/km^2. At this density of one brant/20 ha, the total extent of the potentially contaminated sites is about 38 percent of the area a brant might use.

Glaucous gull. IS = 0.06; the density for the glaucous gull is reported by Derksen et al. (1981) as 0.8 birds/km^2. This density, about one gull/125 ha, yields an IS value of 0.06, indicating that the potentially contaminated sites are about six percent of the area the glaucous gull uses.

Pectoral sandpiper. IS = 1.0; the density of the pectoral sandpiper along the Arctic Coastal Plain is reported by Derksen et al. (1981) as 22.4 birds/km^2. This density equates to one

sandpiper/4.5 ha, and a corresponding IS value of 1.0, which indicates that the sandpiper could meet all its needs within the total area of the potentially contaminated sites.

Spectacled eider. IS = 0.02; Derksen et al. (1981) report an average population density of 0.32 birds/km^2 for the spectacled eider. The resulting density of one bird/312.5 ha in 1981 is currently too high considering the decline in the species' population. The resulting IS value of 0.02 may result in an overestimation of potential exposure, but an overestimation may be considered acceptable in the evaluation of a sensitive species.

Mammals. Brown lemming. IS = 0.5; the lemming's home range is reported as 0.5 ha (Nowak 1991). It is possible that several lemmings may consume all their dietary needs within the bounds of a site. The lemming is not likely, however, to use the wetter sites (which constitute a large portion of the total extent of the sites) where the majority of the contaminant pathways are located. Also, the sites are mostly gravel pads that have been constructed for development purposes, support little or no vegetation, and offer a poor matrix for the lemming to use for burrowing. For these reasons, the IS used for the brown lemming is 0.5 rather than 1.0.

Arctic fox. IS = 0.02 ; the home range of the fox is extremely variable. Eberhardt et al. (1982) report a home range of 3.7 to 20.8 km^2 (370 to 2,080 ha) for juvenile and adult arctic foxes, respectively. Using the lower end of the reported range (370 ha), results in an IS value of 0.02.

Caribou. IS = 0.01; caribou are highly mobile, covering large distances during their movements to and from calving grounds and in their constant search for suitable forage. They may range over thousands of kilometers a year, and as a result there is no accurate estimate of their home range. Based on knowledge of the caribou's habits and professional judgement, a very conservative (likely to overestimate exposure) IS value of 0.01 is used for the caribou.

3.2.7.3 Exposure Assessment for Representative Species of Birds. In this section the methods for quantifying exposures to the selected representative species of birds are presented.

In order to estimate exposures of the representative species of birds, life history information was compiled for the selected species. This information includes occurrence at the DEW Line sites habitat, average body weight, estimated food intake rate, estimated water intake rate, diet composition, and home range and/or population density.

Plant uptake of contaminants has been quantified for use in the exposure estimations for herbivores (bird and mammal species). Herbivores are potentially exposed to contamination directly from ingestion of soil and water intake as well as through their diet. The dietary plant component (CF in the exposure estimate equation) is calculated by multiplying the contaminant's soil concentration by the BCF, B_v. B_v is defined as the ratio of the concentration in aboveground parts of a plant (mg of compound/kg of dry plant) to the concentration in soil (mg of compound/kg of dry soil). The B_v can be used to predict the level of a potential contaminant taken up by a plant, and this information can then be used to assess the potential transport of the contaminant in the trophic web.

The uptake of metals by plants is quantified using the B_v values in Baes et al. (1984). These values represent potential uptake to the vegetative portions of the plant. The approach for organic chemicals is basically the same, except that the B_vs for organic chemicals are derived using a regression equation (Travis and Arms 1988). The equation is:

$$\log B_v = 1.588 - 0.578(\log K_{ow})$$

where:

B_v = the BCF (unitless) and
K_{ow} = the octanol-water partition coefficient of the chemical (mol/m^3 / mol/m^3).

In order to calculate the potential uptake of DRPH by plants, the K_{ow} of diesel fuel was estimated. The estimation of the K_{ow} was conducted using equation 2-3 in Lyman et al. (1982):

$$\log S = -0.922 \log K_{ow} + 4.184$$

where:

S = solubility (mg/L) and
K_{ow} = octanol/water partition coefficient (mol/m^3 / mol/m^3).

This equation estimates the solubility of an organic chemical in water. It may also be manipulated arithmetically to calculate the log K_{ow} based on the known solubility:

$$\log K_{ow} = \frac{\log S - 4.184}{-0.922}$$

The solubility of diesel fuel (0.2 mg/L) (Custance et al. 1992) was used to calculate the log K_{ow} of diesel fuel. The log K_{ow} is calculated to be 5.3.

Life history information for the Lapland longspur, brant, glaucous gull, pectoral sandpiper, and spectacled eider (although the spectacled eider is a threatened species, it is presented with the other avian species) is presented in Tables 3-5 through 3-9.

Information is not available on the daily food intake rate (grams/day) and water intake rate (liters/day) for the representative bird species in the arctic habitat. Therefore, this information was estimated using regression equations associated with body weight (Nagy 1987 for food intake rates; Calder and Braun 1983 for water intake rates). The severity of the arctic climate may impose higher metabolic demands on animals. As a result, the food and water intake rates should be considered estimates only, and their uncertainty should be kept in mind. The food intake rate was estimated using Nagy's (1987) equations:

Passerine birds (i.e., Lapland longspur):

$$\text{FI (kg/day dry matter)} = 0.141 \times (\text{body weight in kilograms})^{0.850}$$

TABLE 3-5. LIFE HISTORY INFORMATION FOR THE LAPLAND LONGSPUR, *Calcarius lapponicus*

PARAMETER	VALUE	NOTES	REFERENCE
Occurrence at DEW Line Sites	Seasonal breeder at all arctic coastal radar installations	Dominant breeding passerine	U.S. Air Force 1993
Habitat	Breeds on arctic coastal tundra		Scott 1983
Body Weight	27.3 g (0.027 kg)	Mean of 68 specimens	Dunning 1984
Food Intake Rate	6.5 g/day dry matter	$FI = 0.141\ (BWkg)^{0.850}$	Nagy 1987
Water Intake Rate	0.005 liters/day	$WI = 0.059\ (BWkg)^{0.67}$	Calder and Braun 1983
Diet Composition	During breeding (June and July): insects (craneflies); pre- and post-breeding (May and August): seeds (grasses); average 25 percent vegetation in diet	Passerine member of insectivorous foraging guild which includes shorebirds	Custer and Pitelka 1978
Population Density	38.6/km^2	Varies with changing predation pressures	Derksen et al. 1981

TABLE 3-6. LIFE HISTORY INFORMATION FOR THE BRANT, *Branta bernicla*

PARAMETER	VALUE	NOTES	REFERENCE
Occurrence at DEW Line Sites	Seasonal breeder at all arctic coastal radar installations	Breeding, migratory sp., subsistence sp.	U.S. Air Force 1993
Habitat	Breeds on Arctic Coastal Plain	Prefers low, barren, wet, coastal terrain	Palmer 1976
Body Weight	1,305 g (1.305 kg)	Mean of 791 specimens	Dunning 1984
Food Intake Rate	69.2 g/day dry matter	$FI = 0.0582\ (BWkg)^{0.651}$	Nagy 1987
Water Intake Rate	0.07 liters/day	$WI = 0.059\ (BWkg)^{0.67}$	Calder and Braun 1983
Diet Composition	Sedges, grasses; average 90 percent vegetation in diet	Some insects during breeding (June and July)	Palmer 1976
Population Density	5.0/km^2	Average from three coastal sites	Derksen et al. 1981

TABLE 3-7. LIFE HISTORY INFORMATION FOR THE GLAUCOUS GULL, *Larus hyperboreus*

PARAMETER	VALUE	NOTES	REFERENCE
Occurrence at DEW Line Sites	Seasonal breeder at all arctic coastal radar installations	Relatively common along arctic coast	Woodward-Clyde 1993
Habitat	Coastal tundra, lakes, ponds, and marine environment	Breeds on arctic coast	Farrand 1983
Body Weight	1,445 g (1.445 kg)	Mean of 65 specimens	Dunning 1984
Food Intake Rate	74 g/day dry matter	$FI = 0.0582 (BWkg)^{0.651}$	Nagy 1987
Water Intake Rate	0.08 liters/day	$WI = 0.059 (BWkg)^{0.67}$	Calder and Braun 1983
Diet Composition	Small fish, birds, insects, crustaceans, mollusks, garbage; average 10 percent of vegetation in diet	Predatory scavenger	Martin et al. 1961
Population Density	$0.8/km^2$	Average from three coastal sites	Derksen et al. 1981

TABLE 3-8. LIFE HISTORY INFORMATION FOR THE PECTORAL SANDPIPER, *Calidris melanotos*

PARAMETER	VALUE	NOTES	REFERENCE
Occurrence at DEW Line Sites	Seasonal breeder at all arctic coastal radar installations	Abundant on Arctic Coastal Plain	Woodward-Clyde 1993
Habitat	Grassy margins of wet meadows, marshes, riparian areas, ponds	Nests hidden on well-drained grassy sites	Scott 1983; Martin et al. 1961
Body Weight	79 g (0.079 kg)	Mean of 35 specimens	Dunning 1984
Food Intake Rate	11.2 g/day dry matter	$FI = 0.0582 (BWkg)^{0.651}$	Nagy 1987
Water Intake Rate	0.01 liter/day	$WI = 0.059 (BWkg)^{0.67}$	Calder and Braun 1983
Diet Composition	Insects, mollusks, crustaceans, worms, vegetable debris; average 10 percent vegetation in diet	Craneflies are major diet component	Martin et al. 1961; Pitelka 1959
Population Density	$22.4/km^2$	Average from three coastal sites	Derksen et al. 1981

TABLE 3-9. LIFE HISTORY INFORMATION FOR THE SPECTACLED EIDER, *Somateria fischeri*

PARAMETER	VALUE	NOTES	REFERENCE
Occurrence at DEW Line Sites	Potential seasonal breeder at all arctic coastal radar installations	Winter whereabouts unknown	Woodward-Clyde 1993; Alaska Biological Research 1994
Habitat	Marine when not breeding, nests on coastal tundra	Nests on islets in tundra ponds and lakes, as well as ashore	Palmer 1976
Body Weight	1,375 g (1.375 kg)	Mean of 32 specimens	Dunning 1984
Food Intake Rate	71.6 g/day dry matter	$FI = 0.0582 (BWkg)^{0.651}$	Nagy 1987
Water Intake Rate	0.07 liters/day	$WI = 0.059 (BWkg)^{0.67}$	Calder and Braun 1983
Diet Composition	75 percent insects, mollusks, crustaceans; average of 25 percent plant matter in diet	Mostly insects when they are abundant; June and July	Kistchinski and Flint 1974
Population Density	$0.32/km^2$	Average of three coastal sites	Derksen et al. 1981

All other birds:

$$FI \text{ (kg/day dry matter)} = 0.0582 \times \text{(body weight in kilograms)}^{0.651}$$

The water intake rate was estimated using the equation developed by Calder and Braun (1983):

All birds:

$$WI \text{ (liters/day)} = 0.059 \times \text{(body weight in kilograms)}^{0.67}$$

As animals forage they may incidentally ingest soil and sediment particles. The average concentration of contaminants in soil/sediment can be multiplied by the amount of soil/sediment ingested to estimate the potential uptake of contaminants by this route. Soil intake rates have been reported for just a few wildlife species (Beyer et al. 1994). The soil ingestion rates for the representative species are extrapolated from Beyer et al. (1994) by using similar species with reported values. The percentages reported are of the total weight of dietary intake. Table 3-10 lists the representative and sensitive bird species, the species used as surrogates, and the estimated percentages of soil ingested in quantifying exposure to contaminants. Species that forage directly in the soil or sediment, such as the sandpiper or goose, show relatively high percentages of soil in their diet. The Lapland longspur does not have appropriate surrogate species with soil ingestion data. Although the longspur is in the same foraging guild as sandpipers (which incidentally ingest relatively large amounts of soil), the longspur takes insects from the soil surface or gleans its prey from vegetation (Custer and Pitelka 1978), thus minimizing its soil intake; the estimate of soil ingestion (less than two percent of diet by weight) reflects this.

TABLE 3-10. SOIL INGESTION ESTIMATES FOR REPRESENTATIVE AND SENSITIVE BIRD SPECIES

REPRESENTATIVE SPECIES	SURROGATE SPECIES	ESTIMATED PERCENT OF SOIL IN DIET	ESTIMATED SOIL IN DIET (g/day)
Lapland longspur	no suitable surrogate	<2.0	0.1
brant	Canada goose	8.2	5.7
glaucous gull	Siberian glaucous gull[a]	7.6	5.6
pectoral sandpiper	four sandpiper species (average)	18.1	2.0
spectacled eider	Canada goose	8.2	5.9

a Data from Belopol'skii 1961.
Source: Beyer et al. 1994.

The glaucous gull ingests stones and sand as a mechanical addition (to aid in digestion) to its diet (Belopol'skii 1961), and this contributes to its soil/sediment intake. For those species without a suitable surrogate or whose soil ingestion rate is reported as <2 percent, a value of two percent of dietary intake (by weight) was used to calculate the exposure estimates.

3.2.7.4 Exposure Assessment for Representative Species of Mammals. This section assesses exposure to contaminants for the selected representative species of mammals. Table 3-11 (brown lemming), Table 3-12 (arctic fox), and Table 3-13 (caribou) present life history data that are used to calculate exposure estimates for the representative mammalian species. Home range and/or population density has been listed for the representative mammal species, depending on appropriateness and availability.

Information on daily food intake rates for the arctic fox and caribou was not available. The rates have been estimated using regression equations associated with average body weights and metabolic rates (Nagy 1987). The food intake rates for the fox and caribou were estimated using the following equations, developed for placental mammals in general and for herbivorous mammals, respectively (Nagy 1987).

arctic fox: using equation for placental mammals in general

$$\text{FI (kg/day dry matter)} = 0.0687 \times (\text{body weight in kilograms})^{0.822}$$

Because of very low assimilation efficiencies, the low nutrient content of winter forage, and the high metabolic demands in arctic habitats (Chappell 1980), the equation for food intake rate significantly underestimates the rate for the brown lemming. A more appropriate rate for the brown lemming of 45 g/day is reported by Chappell (1980) (using the highest value in the reported range of 24 to 45 g/day).

TABLE 3-11. LIFE HISTORY INFORMATION FOR THE BROWN LEMMING, *Lemmus trimucronatus*

PARAMETER	VALUE	NOTES	REFERENCE
Occurrence at DEW Line Sites	Resident at all arctic coastal radar installations	Dominant small mammal	U.S. Air Force 1993
Habitat	Tundra and alpine meadows	Nests above ground in winter, below in summer	Burt and Grossenheider 1976
Body Weight	55 g (0.055 kg)		Chappell 1980
Food Intake Rate	24-45 g/day dry matter	Has low assimilation efficiencies (31 to 36 percent), variation related to seasons	Chappell 1980
Water Intake Rate	0.007 liters/day	$WI = 0.099\ (BWkg)^{0.90}$	Calder and Braun 1983
Diet Composition	Sedges, grasses, lichens, roots, leaves, bark, berries		Nowak 1991
Home Range Size (AVG)	0.5 ha (females) 1.0 ha (males)	0.5 ha used in assessment	Nowak 1991
Population Density	0 to 325/ha	Populations have large fluctuations on a 3-5 year cycle; currently populations are low	Nowak 1991; Snyder-Conn 1994

TABLE 3-12. LIFE HISTORY INFORMATION FOR THE ARCTIC FOX, *Alopex lagopus*

PARAMETER	VALUE	NOTES	REFERENCE
Occurrence at DEW Line Sites	Resident at all arctic coastal radar installations	Ubiquitous	U.S. Air Force 1993
Habitat	Tundra and coastal plain	Dens in sandy mounds >1 m high	Chesemore 1967
Body Weight	4950 g (4.95 kg)		Burt and Grossenheider 1976
Food Intake Rate	256 g/day dry matter	$FI = 0.0687\ (BWkg)^{0.822}$	Nagy 1987
Water Intake Rate	0.42 liters/day	$WI = 0.099\ (BWkg)^{0.90}$	Calder and Braun 1983
Diet Composition	Brown lemming (summer), nesting birds, carrion, seal pups, non-food items	Brown lemming in >85 percent of all scats, n=224	Chesemore 1967; Nowak 1991
Home Range Size (AVG)	20.8 km^2 adult 3.7 km^2 juvenile (<1 yr)	Adult range used in assessment	Eberhardt et al. 1982

TABLE 3-13. LIFE HISTORY INFORMATION FOR THE BARREN-GROUND CARIBOU, *Rangifer tarandus*

PARAMETER	VALUE	NOTES	REFERENCE
Occurrence at DEW Line Sites	Seasonal, at or near all arctic coastal radar installations during migrations	Areas near some installations used for calving	U.S. Air Force 1993
Habitat	Tundra in summer, open coniferous forest in winter	Varies, related to migration	Burt and Grossenheider 1976
Body Weight	95,500 g (95.5 kg)	Mean for adults	Nowak 1991
Food Intake Rate	2400 g/day (2.4 kg) dry matter	$FI = 0.0875\ (BWkg)^{0.727}$	Nagy 1987
Water Intake Rate	6.0 liters/day	$WI = 0.099\ (BWkg)^{0.90}$	Calder and Braun 1983
Diet Composition	Willows, sedges, cottongrass, lichens	Selection based on plant phenology	Skogland 1980; White and Trudell 1980
Population Density	1.41 km^2 0.31 km^2 4.53 km^2	Undisturbed calving area Within one km of road Within 5-6 km of road	Cameron et al. 1992

caribou: using equation for mammalian herbivores

$$FI\ (kg/day\ dry\ matter) = 0.0875 \times (body\ weight\ in\ kilograms)^{0.727}$$

The rates for water intake of the representative mammals were estimated using the equation generated by Calder and Braun (1983) because of the unavailability of species-specific information in the literature. The equation is:

$$WI\ (liters/day) = 0.099 \times (body\ weight\ in\ kilograms)^{0.90}$$

Incidental soil intake was evaluated for mammals in the same manner as for birds (Section 3.2.7.3). Table 3-14 shows the percent of soil ingested for the representative mammal species.

3.3 ECOLOGICAL TOXICITY ASSESSMENT

This section presents toxicity information for each COC in surface water and soil/sediment. The COCs identified in surface water are iron, manganese, GRPH, and tetrachloroethene (Section 3.1.1). The COCs in soil/sediment are DRPH, GRPH, benzene, and xylenes (Section 3.1.2). Sections 3.3.1 through 3.3.6 discuss the toxicity of all COCs to the receptor groups. Section 3.3.7 presents the methodology for the derivation of TRVs used in this ERA.

TABLE 3-14. SOIL INGESTION ESTIMATES FOR REPRESENTATIVE MAMMAL SPECIES

REPRESENTATIVE SPECIES	SURROGATE SPECIES	ESTIMATED PERCENT OF SOIL IN DIET	ESTIMATED SOIL IN DIET (g/day)
Brown lemming	White-tailed prairie dog	2.7	1.2
Arctic fox	Red fox	2.8	7.2
Caribou	Elk	<2.0	48

Source: Beyer et al. 1994.

3.3.1 Petroleum Hydrocarbons

Petroleum hydrocarbons were identified as COCs in surface water (GRPH) and soil/sediment (DRPH, GRPH, and RRPH). This section is a discussion of the chemical compositions of DRPH, GRPH, and RRPH and the toxicity of these petroleum mixtures.

Crude petroleum contains thousands of different chemical compounds. Gasoline and diesel fuel are refined petroleum products. The composition of gasoline and diesel fuel depends on not only the origin of the crude oil from which the gasoline is derived, but also the process technique and the blending scheme (Von Burg 1993). Once gasoline or diesel fuel is released to the environment, weathering and volatilization further alter its composition.

Gasoline is a complex, highly variable mixture of petroleum hydrocarbons containing 3 to 21 carbon atoms; however, compounds with 4 to 12 carbon atoms predominate. Gasoline is detected with the petroleum hydrocarbon analysis as GRPH. The following chemical classes are detected as GRPH: paraffins (straight-chained alkanes), olefins (straight-chained alkenes), naphthenes (cycloalkanes and alkenes), and aromatic hydrocarbons [alkylbenzenes and polycyclic aromatic hydrocarbons (PAHs)] (Von Burg 1993). Although GRPH are generally in the range of 4 to 12 carbon atoms, the laboratory that conducted the analyses for Point Lonely detected GRPH with 6 to 9 carbon atoms. As many as 140 compounds have been identified as constituents of gasoline; however, constituents such as benzene drive the toxicity. Diesel fuel is also a complex, variable mixture of the same classes of compounds containing 6 to 21 carbon atoms. Diesel fuel is detected with the petroleum hydrocarbon analysis as DRPH. The laboratory that analyzed samples for Point Lonely detected DRPH with 10 to 24 carbons atoms. As many as 45 compounds have been identified as constituents of diesel fuel (Von Burg 1993).

Table 3-15 presents the chemical classes and weight percent for GRPH and DRPH. Generally, gasoline contains more aromatic compounds and simple-chained alkanes, whereas diesel fuel is characterized by cycloparaffins (or cycloalkanes). Both gasoline and diesel fuel will be affected by the environment. Weathering will change the chemical composition of petroleum, and concentrations of aromatic compounds such as benzene will decrease as a result of volatilization.

TABLE 3-15. CHEMICAL CLASSES OF GRPH AND DRPH

CHEMICAL CLASS	WEIGHT PERCENT[a]
GRPH[b]	
Normal paraffins (n-alkanes)	19.3-38.4 (28.8)
Isoparaffins (isoalkanes)	11.5-50.3 (30.9)
Naphthenes (cycloparaffins or cycloalkanes)	1.0-2.8 (1.9)
Aromatics (e.g., benzene, toluene, pyrene)	9.7-54.7 (32.2)
DRPH[c]	
Normal paraffins (n-alkanes)	5.6
Isoparaffins (isoalkanes)	11.1
Naphthenes (cycloparaffins or cycloalkanes)	46.3
Aromatics (e.g., benzene, toluene, pyrene)	33.3
Nitrogen, sulfur and oxygen compounds	3.7

a Average shown in parentheses.
b Heath et al. 1993.
c Weeks et al. 1988.

Available toxicity test data have been derived from pure, fresh product, and therefore, the applicability to the weathered product encountered at Point Lonely is uncertain. Gasoline is the most studied of the petroleum products; however, most data are based on inhalation studies. Gasoline was classified by EPA (1992b) as a Group C (possible human) carcinogen, whereas diesel oil was classified as Group D (not classifiable as to human carcinogenicity). Presumably, this classification of gasoline is due to benzene, which, under the conditions of environmental exposure, would volatilize more rapidly than any other constituent. Physical-chemical data from the literature indicates that total petroleum hydrocarbons (TPH) in soil would reflect all constituents with eventual loss of aromatic (e.g., BTEX) components first, lighter alkanes second, lighter PAHs third, followed by naphthalenes. For an old diesel or petroleum spill, petroleum hydrocarbon measurements may reflect predominantly trace amounts of high molecular-weight PAHs or higher molecular-weight and branched alkanes [Massachusetts Department of Environmental Protection (MDEP) 1993].

For the purposes of ranking the toxicity of GRPH and DRPH, it was assumed that BTEX and lighter-weight alkanes have been significantly weathered from exposure to the arctic environment, and that toxicity is more dependent upon noncarcinogenic endpoints associated with alkanes,

alkenes, and cycloalkanes. The toxicity of DRPH is also associated with the PAH content. At Point Lonely however, no PAHs were detected. MDEP (1993) reviewed the noncarcinogenic toxicological endpoints in laboratory animals for diesel fuel and gasoline, and determined that diesel fuel was an order of magnitude more toxic than gasoline, although other sources indicate the toxicity of alkanes and cycloalkanes is similar (Armstrong Laboratory 1994; Sax and Lewis 1989). A review of the Point Lonely data indicates that DRPH are present at higher concentrations than GRPH in soil/sediment. Specifically, average concentrations of DRPH in soil/sediment were approximately 16 times greater than average concentrations of GRPH in soil/sediment. As a result, based on the MDEP review and the chemical data reported for the Point Lonely soil/sediment samples, the evaluation of DRPH is used to conservatively represent ecological risks from petroleum hydrocarbon contamination in soil/sediment (i.e., including GRPH and other constituent chemicals such as n-butylbenzene, p-isopropyltoluene, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene).

The following subsections summarize the toxicity of diesel fuel (DRPH) and gasoline (GRPH) to plants, aquatic organisms, birds, and mammals. The compounds are grouped together in the following discussions because the constituents that drive the toxicity of DRPH and GRPH are often the same.

3.3.1.1 Plants. Petroleum released to the aquatic environment may be toxic to aquatic plants. Toxicity tests have shown that the water-soluble components of petroleum are toxic to an algal species (*Chlorella vulgaris*) (Kauss and Hutchinson 1975); however, in this specific study, the toxicity was short term. The algal community recovered after a "lag phase". It was theorized (Kauss and Hutchinson 1975) that this trend was due to the loss of highly volatile fractions from the testing chamber over time. Exposure to water extracts of No. 2 Fuel Oil depressed algal biomass in communities and resulted in blue-green algal dominance and decreased diatom occurrence (Bott and Rogenmuser 1978). No data was available concerning plant exposure to GRPH, but the data for DRPH may be used to evaluate the exposure to GRPH.

3.3.1.2 Aquatic Organisms. Moles et al. (1979) tested the acute toxicity of Prudhoe Bay crude oil to several Alaskan freshwater and anadromous fish. Salmonids were the most sensitive species tested, and demonstrated median tolerance limits [the concentration at which one half the organisms survive in 96 hours, same as LC_{50} (lethal concentration for 50 percent of the organisms)] ranging from 2.7 to 4.4 mg/L. The three-spined stickleback, *Gasterosteus aculeatus*, was more tolerant, with an LC_{50} of 10.4 mg/L. Klein and Jenkins (1983) studied the toxicity of the water-soluble fraction of jet fuel to fish. Growth of fry was retarded by 1.5 mg/L of the water-soluble fraction of JP-8 (jet fuel with de-icer). In a study conducted by Hedtke and Puglisi (1982), the method of introducing the oil to the test chamber was an important variable driving toxicity. Emulsified oils were substantially more toxic than either floating oils or the water-soluble fraction. The 96-hour LC_{50} for fathead minnows (*Pimephales promelas*) exposed to the emulsion of No. 2 Jet Fuel was 38.6 mg/L (concentration used to calculate the TRV for GRPH and DRPH). Because no toxicity data was available for GRPH and fish, the jet fuel data were used to evaluate the nine-spined stickleback's exposure to GRPH.

Aquatic organisms other than fish may also be exposed to diesel fuel in the environment. Studies have shown that freshwater arctic zooplankton may be more sensitive to oil pollution

than any other arctic freshwater organisms (O'Brien 1978). Geiger and Buikema (1981) estimated an LC_{20} (concentration lethal to 20 percent of the test organisms) of No. 2 Fuel Oil to *Daphnia pulex* of 5.6 mg/L (concentration used to calculate TRV). These data are used to evaluate *Daphnia* exposure to GRPH.

3.3.1.3 Birds. Petroleum hydrocarbons in the environment may affect bird reproduction. External application of No. 2 Fuel Oil to mallard (*Anas platyrhynchos*) and common eider (*Somateria mollissima*) eggs significantly increased embryo mortality (Albers 1977; Szaro and Albers 1977). Mallard eggs were treated with 1, 5, 10, 20, and 50 μl of fuel oil. Ingestion of crude oil by mallards at a concentration of five percent by weight in the diet resulted in depressed growth (Szaro et al. 1978). Hartung (1964) demonstrated a decrease in weight gain in mallards during the first 10 days after receiving 6,000 mg/kg No. 2 Fuel Oil (concentration used to calculate the DRPH TRV); however, after 34 days, there was no difference between treatment groups and the controls. No toxicity data was available for avian exposure to GRPH specifically, but the evaluation of DRPH, in addition to a comparison of avian and mammalian GRPH toxicities (presented in Section 3.4.3, Risk Characterization), will serve to assess avian GRPH exposure.

3.3.1.4 Mammals. The toxicity of DRPH and GRPH to the representative mammals can be evaluated using the toxicity of the compound to rats. Diesel fuel is relatively nontoxic to rats based on an acute oral LD_{50} (lethal dose for 50 percent of the organisms) of 7,380 mg/kg (Beck et al. 1982) (dose used to calculate TRV). Based on subchronic renal studies using rats exposed to unleaded gasoline, a NOAEL of 500 mg/kg was reported (ATSDR 1993b). This dose was used to calculate the GRPH TRV for mammals.

3.3.2 Benzene

Benzene is a COC in soil/sediment at the Point Lonely sites. It is an highly volatile aromatic hydrocarbon that is used as a solvent and in the synthesis of other chemicals. Benzene is typically a component of petroleum products and is found naturally in the environment (ATSDR 1993a; Klaassen et al. 1986). The major toxic effect of benzene in animals is hematopoietic toxicity (i.e., blood disorders, including anemia and leukemia) (Klaassen et al. 1986). A summary of the relevant toxicity information is presented below.

3.3.2.1 Plants. No information was available concerning the toxicity of benzene to plants. A qualitative discussion of the toxicity of VOCs to plants is presented in Section 3.4.1, Risk Characterization.

3.3.2.2 Aquatic Organisms. No aquatic toxicity information is presented because benzene was not selected as a COC in surface water.

3.3.2.3 Birds. No toxicity information was available for benzene toxicity to birds. A qualitative discussion and comparison of mammalian and avian toxicity values is presented in Section 3.4.3, Risk Characterization.

3.3.2.4 Mammals. Nawrot and Staples (1979 in Opresko et al. 1994) reported a chronic reproductive LOAEL for laboratory mice orally exposed to benzene as 263.6 mg/kg. Using an

UF of 0.1, Opresko et al. (1994) convert the LOAEL to a chronic NOAEL for mice of 26.36 mg/kg. This is the value used to calculate the benzene TRV for mammals.

3.3.3 Tetrachloroethene

Tetrachloroethene is a chemical of concern in surface water and soil/sediment at the Point Lonely sites. It is a halogenated hydrocarbon used in commercial dry cleaning operations and as a solvent. It has demonstrated experimental carcinogenic, teratogenic, and reproductive effects (Sax and Lewis 1989). Toxicity information for this compound is limited and is summarized below.

3.3.3.1 Plants. Suter and Mabrey (1994) report the lowest chronic benchmark value for aquatic plants exposed to tetrachloroethene as greater than 816,000 μg/L.

3.3.3.2 Aquatic Organisms. Suter and Mabrey (1994) report the lowest chronic benchmarks for fish and *Daphnia* exposed to tetrachloroethene as 840 and 750 μg/L, respectively. The 750 μg/L value is used as the TRV for aquatic organisms.

3.3.3.3 Birds. No avian toxicity information for tetrachloroethene was available. A qualitative discussion and comparison of avian and mammalian toxicity values are presented in Section 3.4.3, Risk Characterization.

3.3.3.4 Mammals. Buben and O'Flaherty (1985 in Opresko et al 1994) conducted a six week subchronic exposure test of tetrachloroethene on mice. A subchronic NOAEL was determined to be 20 mg/kg. Applying conversion and UF specified in Opresko et al. (1994), a final NOAEL of 1.4 mg/kg was derived. This is the value used to calculate the TRV.

3.3.4 Xylene

Xylene is a COC in soil/sediment at the Point Lonely sites. It is an alkylbenzene, a common constituent of petroleum products (ATSDR 1993a). Most toxicity information in the literature relates to the inhalation of xylene. A summary of the relevant information is presented below.

3.3.4.1 Plants. In a study of the green algae, *Selenastrum capricornutum*, xylene decreased growth at concentrations of 72,000 μg/L (Gaur 1988 in AQUIRE 1990).

3.3.4.2 Aquatic Organisms. No aquatic toxicity information is presented because xylene was not identified as a COC in surface water.

3.3.4.3 Birds. When mallard eggs were immersed in xylene (1 percent and 10 percent) for 30 seconds, there was no significant effect on embryonic weight and length when compared to controls [Hoffman and Eastin 1981 in Hazardous Substances Data Bank (HSDB) 1994]. Japanese quail (*Coturnix japonica*) fed xylene demonstrated no sign of toxicity up to 5,000 ppm (USFWS 1986). The LC_{50} was >20,000 ppm (USFWS 1986). Hill and Camardese (1986) report a maximum dietary exposure level for Japanese quail of 608 mg/kg total xylenes (dose used to calculate TRV).

3.3.4.4 Mammals. Ingestion of xylene in mammals may cause prenatal mortality, growth inhibition, and malformations, primarily cleft palate. The LD_{50} for ingestion of xylene (rat) was reported as 4,300 mg/kg (Clayton and Clayton 1981) (dose used to calculate TRV).

3.3.5 Iron

Iron was identified as a COC in surface water at the Point Lonely sites. Iron is an essential trace element required by both plants and animals. It plays an important role in the transport of oxygen in animals. Available information for iron is summarized below.

3.3.5.1 Plants. In a study conducted by Foy et al. (1978 in EPA 1985), concentrations of 100 to 500 ppm soluble iron in soil were toxic to rice.

3.3.5.2 Aquatic Organisms. Iron may be a threat in aquatic environments in the form of precipitates that can destroy habitat, coat gills, and inhibit oxygen uptake. Suter and Mabrey (1994) report lowest chronic screening benchmarks for fathead minnow and *Daphnia* spp. as 8,784 and 4,400 µg/L, respectively. These values are used to establish the aquatic TRVs.

3.3.5.3 Birds. There are few studies available that address the toxicity of iron to species of wild birds. There were no adverse effects produced in turkeys at concentrations of 440 ppm (Woerpel and Balloun 1964 in NAS 1980). NAS (1980) recommends that the maximum tolerable level of dietary iron of 1,000 ppm be used for poultry. The 1,000 ppm dose converts to 70.0 mg/kg for a maximum tolerable dietary level for a chicken (dose used to calculate TRV).

3.3.5.4 Mammals. At high concentrations, iron is toxic to livestock and interferes with phosphorus metabolism (NAS 1974 in EPA 1976). Cattle fed 477 µg/g iron demonstrated a slight decrease in weight gain; concentrations of 1,677 µg/g of iron produced a significant decline in growth rate (EPA 1985). Shanas and Boyd (1969 in NAS 1980) report an acute LD_{50} dose of 1,000 mg/kg for the rat (dose used to calculate TRV for brown lemming and arctic fox). The maximum tolerable dietary level of 500 ppm of iron (converted to 20 mg/kg) for sheep is used to calculate the TRV for caribou (NAS 1980).

3.3.6 Manganese

Manganese was determined to be a COC in surface water. Manganese is considered to be an essential nutrient for animals (ATSDR 1990b), and it is important for growth and reproduction. The toxicity of manganese can be affected by pH and water hardness, although these interactions were not analyzed for the Point Lonely sites. Available information for manganese is summarized below.

3.3.6.1 Plants. In a four-day study conducted using duckweed (*Lemna minor*), an EC_{50} (reduction in growth) of 31,000 µg/L was reported (Wang 1986 in AQUIRE 1990). Lewis et al. (1979) studied the species composition of freshwater phytoplankton populations when exposed to manganese. Population composition was altered at 0.1 mg/L manganese. Soil concentrations of 1,500 to 3,000 mg/kg were reported as phytotoxic to all plant species (Kabata-Pendias and Pendias 1984).

3.3.6.2 Aquatic Organisms. Suter and Mabrey (1994) report lowest chronic screening benchmarks for fathead minnow and *Daphnia* spp. as 1,770 and 1,100 μg/L, respectively. These values are used to establish the aquatic TRVs for manganese.

3.3.6.3 Birds. Vohra and Kratzer (1968 in NAS 1980) exposed young turkeys to dietary manganese for 21 days. A NOEL of 4,080 ppm was derived. The maximum tolerable level of manganese that is recommended by the NAS is 2,000 ppm (250 mg/kg body weight) for poultry. This is the value used to calculate the avian TRV.

3.3.6.4 Mammals. When fed 9,000 ppm manganese, sheep demonstrated reduced feed intake (Puls 1988). NAS (1980) recommends maximum tolerable levels of 1,000 ppm for cattle (15 mg/kg body weight) and sheep (40 mg/kg body weight). The value for sheep is used to calculate the TRV for caribou. A NOAEL of 930 mg/kg-bw/day is reported for rats in ATSDR (1990b). The TRVs for brown lemming and arctic fox are based on the 930 mg/kg dose.

3.3.7 Characterization of Effects

In this section, toxicity information is presented for representative ecological receptors evaluated in the risk characterization (Section 3.4). Potential impacts to aquatic receptors are evaluated by comparing exposure concentrations to TRVs. TRVs for the representative aquatic species are presented in Table 3-16. Potential impacts to terrestrial wildlife are evaluated for the representative species based on comparisons of estimated exposures to TRVs. Exposure to COCs for the representative terrestrial species is primarily through diet, which may include plants, fish, aquatic invertebrates, soils, and surface water. TRVs are derived for COCs in surface water and soil/sediment. TRVs for the representative and sensitive bird species are presented in Table 3-17, and for the representative mammal species in Table 3-18.

3.3.7.1 Toxicity Reference Values. TRVs are derived by selecting toxicity values from the literature and extrapolating to the species of concern. UF and body scaling factors are used in the extrapolation process as described below.

(1) The first step is to select an appropriate toxicity value from the scientific literature for each combination of chemical and representative or protected species. Test species most similar to the species of concern are preferred. A secondary emphasis is given to tests conducted over a significant portion of the animal's natural lifespan (i.e., chronic tests) when available.

(2) The second step is to modify the toxicity value, if necessary, through application of UF associated with the quality of toxicity data to derive a NOAEL (the highest concentration of a material in a toxicity test that has no statistically significant adverse effect on the exposed population of test organisms as compared with the next highest dose tested). If a chronic NOAEL or No Observed Effect Level (NOEL) is available, it is used with an UF of one (i.e., no adjustment) because these values have the lowest uncertainty. If chronic data are unavailable, acute or subchronic toxicity data are modified by uncertainty factors to extrapolate to chronic effects. Based on Harding Lawson Associates (1992), the following

TABLE 3-16. TOXICITY REFERENCE VALUES FOR REPRESENTATIVE SPECIES OF AQUATIC ORGANISMS AT THE POINT LONELY INSTALLATION

CHEMICAL OF CONCERN	REPRESENTATIVE SPECIES	STUDY TYPE	CONCENTRATION (μg/L)	TEST SPECIES	NOAEL UF	INTERSPECIES UF	PROTECTED SPECIES UF	TRV (μg/L)	REFERENCE
GRPH[a]	nine-spined stickleback	LC_{50}	38,600	fathead minnow	20	2	1	965	Hedtke and Puglisis 1982
GRPH[a]	*Daphnia* spp.	LOAEL	5,600	*D. pulex*	20	1	1	280	Hedtke and Puglisis 1982
Tetrachloroethene	nine-spined stickleback	LC_{50}	21,400	fathead minnow	20	2	1	535	Suter and Mabrey 1994
Tetrachloroethene	*Daphnia* spp.	LC_{50}	17,700	*D. magna*	20	1	1	443	Suter and Mabrey 1994
Iron	nine-spined stickleback	lowest chronic benchmark	8,784	fathead minnow	1	2	1	4,392	Suter and Mabrey 1994
Iron	*Daphnia* spp.	lowest chronic benchmark	4,400	*Daphnia* spp.	1	1	1	4,400	Suter and Mabrey 1994
Manganese	nine-spined stickleback	28 day LC_{50}	1,770	fathead minnow	1	2	1	885	Suter and Mabrey 1994
Manganese	*Daphnia* spp.	chronic reproductive impairment NOAEL	1,100	*Daphnia* spp.	1	1	1	1,100	Suter and Mabrey 1994

[a] Toxicity information shown is for DRPH; no data available for GRPH.

TABLE 3-17. TOXICITY REFERENCE VALUES FOR REPRESENTATIVE AND SENSITIVE SPECIES OF BIRDS AT THE POINT LONELY INSTALLATION

CHEMICAL OF CONCERN	REPRESENTATIVE SPECIES	STUDY TYPE	DOSE mg/kg-bw/day	TEST SPECIES	NOAEL UF	SCALING FACTOR	INTERSPECIES UF	PROTECTED SPECIES UF	TRV mg/kg-bw/day	REFERENCE
Iron	Lapland longspur	NOAEL; 28 day growth study	70.0	chicken	1	0.32	2	2	54.7	McGhee et al. 1965 in NAS 1980
Iron	brant	NOAEL; 28 day growth study	70.0	chicken	1	1.18	2	2	14.8	McGhee et al. 1965 in NAS 1980
Iron	glaucous gull	NOAEL; 28 day growth study	70.0	chicken	1	1.22	2	2	14.3	McGhee et al. 1965 in NAS 1980
Iron	pectoral sandpiper	NOAEL; 28 day growth study	70.0	chicken	1	0.46	2	2	38.0	McGhee et al. 1965 in NAS 1980
Iron	spectacled eider	NOAEL; 28 day growth study	70.0	chicken	1	1.20	2	2	14.6	McGhee et al. 1965 in NAS 1980
Manganese	Lapland longspur	systemic LOAEL	250	chicken	10	0.32	2	2	19.5	NAS 1980
Manganese	brant	systemic LOAEL	250	chicken	10	1.18	2	2	5.3	NAS 1980
Manganese	glaucous gull	systemic LOAEL	250	chicken	10	1.22	2	2	5.1	NAS 1980
Manganese	pectoral sandpiper	systemic LOAEL	250	chicken	10	0.46	2	2	13.6	NAS 1980
Manganese	spectacled eider	systemic LOAEL	250	chicken	10	1.20	2	2	5.2	NAS 1980
DRPH	Lapland longspur	decreased weight gain LOAEL	6,000	mallard	10	0.29	2	2	517	Hartung 1964
DRPH	brant	decreased weight gain LOAEL	6,000	mallard	10	1.07	2	2	140	Hartung 1964

TABLE 3-17. TOXICITY REFERENCE VALUES FOR REPRESENTATIVE AND SENSITIVE SPECIES OF BIRDS AT THE POINT LONELY INSTALLATION (CONTINUED)

CHEMICAL OF CONCERN	REPRESENTATIVE SPECIES	STUDY TYPE	DOSE mg/kg-bw/day	TEST SPECIES	NOAEL UF	SCALING FACTOR	INTERSPECIES UF	PROTECTED SPECIES UF	TRV mg/kg-bw/day	REFERENCE
DRPH	glaucous gull	decreased weight gain LOAEL	6,000	mallard	10	1.10	2	2	136	Hartung 1964
DRPH	pectoral sandpiper	decreased weight gain LOAEL	6,000	mallard	10	0.42	2	2	357	Hartung 1964
DRPH	spectacled eider	decreased weight gain LOAEL	6,000	mallard	10	1.08	2	2	139	Hartung 1964
GRPH	No avian data available for GRPH; defer to DRPH data as surrogate toxicity information.									
Benzene	No avian toxicity data available for benzene; see discussion in Section 3.4.3, Potential Risks to Representative Species of Birds.									
Tetrachloroethene	No avian toxicity data available for tetrachloroethene; see discussion in Section 3.4.3, Potential Risks to Representative Species of Birds.									
Xylene	Lapland longspur	Maximum dietary exposure	608	Japanese quail	10	0.60	2	2	25	Hill and Camardese 1986
Xylene	brant	Maximum dietary exposure	608	Japanese quail	10	2.16	2	2	7	Hill and Camardese 1986
Xylene	glaucous gull	Maximum dietary exposure	608	Japanese quail	10	2.23	2	2	7	Hill and Camardese 1986
Xylene	pectoral sandpiper	Maximum dietary exposure	608	Japanese quail	10	0.85	2	2	18	Hill and Camardese 1986
Xylene	spectacled eider	Maximum dietary exposure	608	Japanese quail	10	2.39	2	2	6	Hill and Camardese 1986

TABLE 3-18. TOXICITY REFERENCE VALUES FOR REPRESENTATIVE SPECIES OF MAMMALS AT THE POINT LONELY INSTALLATION

CHEMICAL OF CONCERN	REPRESENTATIVE SPECIES	STUDY TYPE	DOSE mg/kg-bw/day	TEST SPECIES	NOAEL UF	SCALING FACTOR	INTERSPECIES UF	PROTECTED SPECIES UF	TRV mg/kg-bw/day	REFERENCE
DRPH	brown lemming	LD_{50}	7,380	rat	20	0.60	2	1	308	Beck et al. 1982
DRPH	arctic fox	LD_{50}	7,380	rat	20	2.70	2	1	68	Beck et al. 1982
DRPH	caribou	LD_{50}	7,380	rat	20	7.24	2	1	25	Beck et al. 1982
GRPH	brown lemming	subchronic renal effects NOAEL	500	rat	10	0.60	2	1	42	ATSDR 1993b
GRPH	arctic fox	subchronic renal effects NOAEL	500	rat	10	2.70	2	1	9	ATSDR 1993b
GRPH	caribou	subchronic renal effects NOAEL	500	rat	10	7.24	2	1	3	ATSDR 1993b
Benzene	brown lemming	reproductive NOAEL	26.36	mouse	1	1.30	2	1	10	Nawrot and Staples 1979 in Opresko et al. 1994
Benzene	arctic fox	reproductive NOAEL	26.36	mouse	1	5.82	2	1	2	Nawrot and Staples 1979 in Opresko et al. 1994
Benzene	caribou	reproductive NOAEL	26.36	mouse	1	15.59	2	1	1	Nawrot and Staples 1979 in Opresko et al. 1994
Tetrachloroethene	brown lemming	hepatic NOAEL	1.4	mouse	1	1.30	2	1	0.53	Buben and O'Flaherty 1985 in Opresko et al. 1994

TABLE 3-18. TOXICITY REFERENCE VALUES FOR REPRESENTATIVE SPECIES OF MAMMALS AT THE POINT LONELY INSTALLATION (CONTINUED)

CHEMICAL OF CONCERN	REPRESENTATIVE SPECIES	STUDY TYPE	DOSE mg/kg-bw/day	TEST SPECIES	NOAEL UF	SCALING FACTOR	INTERSPECIES UF	PROTECTED SPECIES UF	TRV mg/kg-bw/day	REFERENCE
Tetrachloroethene	arctic fox	hepatic NOAEL	1.4	mouse	1	2.70	2	1	0.12	Buben and O'Flaherty 1985 in Opresko et al. 1994
Tetrachloroethene	caribou	hepatic NOAEL	1.4	mouse	1	7.24	2	1	0.05	Buben and O'Flaherty 1985 in Opresko et al. 1994
Xylenes (total)	brown lemming	LD_{50}	4,300	rat	20	0.60	2	1	179	Clayton and Clayton 1981
Xylenes (total)	arctic fox	LD_{50}	4,300	rat	20	2.70	2	1	40	Clayton and Clayton 1981
Xylenes (total)	caribou	LD_{50}	4,300	rat	20	7.24	2	1	15	Clayton and Clayton 1981
Iron	brown lemming	Acute LD_{50}	1,000	rat	20	0.60	2	1	42	Shanas and Boyd 1969 in NAS 1980
Iron	arctic fox	Acute LD_{50}	1,000	rat	20	2.70	2	1	9	Shanas and Boyd 1969 in NAS 1980
Iron	caribou	maximum tolerable dietary level NOAEL	20	sheep	1	1.17	2	1	9	NAS 1980
Manganese	brown lemming	chronic systemic NOAEL	930	rat	1	0.60	2	1	780	Hejtmanick et al. 1987 in ATSDR 1990
Manganese	arctic fox	chronic systemic NOAEL	930	rat	1	2.70	2	1	170	Hejtmanick et al. 1987 in ATSDR 1990
Manganese	caribou	maximum tolerable dietary level NOAEL	40	sheep	1	1.17	2	1	17	NAS 1980

strategy was derived for UF for extrapolating study results to chronic NOAELs: 10 for chronic low observed effect level (LOEL) values, 10 for subchronic NOEL values, and 20 for subchronic LOEL values. LC_{50} and LD_{50} values are extrapolated to chronic NOAELs by a factor of 20.

(3) The third step is applicable only to terrestrial receptors. This step extrapolates the estimated NOAEL from the test species to a NOAEL for the species of concern using a body scaling factor. Klaassen et al. (1986) have indicated that dose expressed per unit surface area may be more appropriate than dose per unit body weight. The underlying assumption is that a toxicant acts on a physiologic surface and that the toxic effect increases as the ratio of chemical to surface area increases. The scaling factor (SF) accounts for differences in the mass to surface area ratios between species. In this assessment the scaling factor is calculated using the following equation (Mantel and Schneiderman 1975) (scaling factors are presented in Appendix F):

$$SF = (\text{weight of representative species/weight of test species})^{1/3}.$$

(4) An UF of two is used to account for interspecies variation in sensitivity. This value is based on the methodology used in Harding Lawson Associates (1992).

(5) An UF of two was used to account for additional sensitivity of state and/or federally protected species. This value is based on Harding Lawson Associates (1992). Migratory birds are federally protected and include all the representative avian and protected species selected for this assessment.

The methods of calculating the TRV for the terrestrial and aquatic receptors are as follows:

TERRESTRIAL:

a) Convert test dose to a NOAEL:
DOSE 1 ÷ **NOAEL UF** = Estimated NOAEL

b) Adjust for body size difference between test species and ROC:
Estimated NOAEL ÷ **SCALING FACTOR** = Scaled, estimated NOAEL

c) Adjust for interspecific differences:
Scaled, estimated NOAEL ÷ **INTERSPECIES UF** = Species-specific, scaled, estimated NOAEL.

d) Account for protected species status:
Species-specific, scaled, estimated NOAEL ÷ **PROTECTED SPECIES UF** = **TRV**

AQUATIC:

EFFECTIVE CONCENTRATION ÷ NOAEL UF ÷ INTERSPECIES UF = TRV

3.4 RISK CHARACTERIZATION FOR ECOLOGICAL RECEPTORS

HQs for the representative species are presented in this section. Potential risks to plants are evaluated based on the contaminant concentrations in the soil/sediment and information from the literature. Potential risks to aquatic organisms, birds, and mammals are estimated by comparing estimated exposures to TRVs (i.e., quotient method). The quotient method divides the estimated exposure concentration by the associated TRV to derive the HQ. If the HQ is less than 1.0, adverse effects are not expected. Conversely, if the HQ is equal to, or greater than, 1.0, a potential for adverse effects exists. The confidence level of the risk estimate is increased as the magnitude of the HQ departs from 1.0. For example, there is greater confidence in a risk estimate where the HQ is 0.1 or 10, than in a HQ such as 0.9 or 1.1. The confidence level is also dependent on the uncertainty associated with the estimated exposure and the TRV for a given chemical-receptor combination.

The characterization of risk focuses on the assessment endpoints. These endpoints are selected and discussed in keeping with the Framework for Ecological Risk Assessment guidance (EPA 1992a). The assessment endpoints for the Point Lonely ERA are changes in:

- The populations of the plant representative species (*Carex* spp., *Salix* spp., *Eriophorum* spp., and *Vaccinium* spp.);
- The populations of aquatic representative species (*Daphnia* spp. and nine-spined stickleback);
- The populations of avian representative and sensitive species (Lapland longspur, brant, glaucous gull, pectoral sandpiper, and spectacled eider); and
- The populations of mammalian representative species (brown lemming, arctic fox, and barren-ground caribou).

The measurement endpoints used to evaluate potential changes in populations of the representative species were based on the endpoints used to derive the TRVs. These endpoints included physiological effects, growth, reproduction, and mortality.

Potential ecological risks to representative species are presented in the following sections: Section 3.4.1 addresses plants; Section 3.4.2 considers aquatic organisms; Section 3.4.3 addresses birds; and Section 3.4.4 discusses mammals. A discussion of potential future risks to ecological receptors is presented in Section 3.4.5. Toxicity information and the HQs that represent potential risk estimates are summarized in tables presented within these sections.

3.4.1 Potential Risks to Representative Species of Plants

In determining the risks to plants at the Point Lonely sites, a qualitative comparison was made of soil and surface water contaminant concentrations and plant toxicity information in the literature. Table 3-19 summarizes these comparisons. There is a great deal of uncertainty in this phase of the assessment because of the differences in degree of uptake between plant species

TABLE 3-19. COMPARISON OF COC CONCENTRATIONS TO TOXICITY INFORMATION FOR PLANTS AT THE POINT LONELY INSTALLATION

CHEMICAL (COC media)	PLANT	EXPOSURE LEVEL	EFFECT ON PLANT	POINT LONELY EXPOSURE	REFERENCE
IRON (COC in water)	rice	100,000-500,000 µg/L; >500,000 µg/L	toxic; highly toxic	3,000 µg/L	USACOE 1991
MANGANESE (COC in water)	duckweed	31,000 µg/L in water	EC^{50}	620 µg/L	USACOE 1991
TETRACHLOROETHENE (COC in water and soil/sediment)	aquatic plants	>816,000 µg/L	chronic screening benchmark	230 µg/L 0.27 mg/kg	Suter and Mabrey 1994
VOCs (COCs as GRPH in water; as DRPH, GRPH, toluene, and xylene in soil/sediment)	green algae	4,600 µg/L for ethylbenzene 2,290 µg/L for methylene chloride, in water	EC_{50}	GRPH = 140 µg/L DRPH = 380 µg/L GRPH = 23mg/kg benzene = 0.10mg/kg xylenes = 0.28 mg/kg	USACOE 1991

(Walker et al. 1978); however, the concentrations of contaminants onsite can be compared on the level of orders of magnitude, which can identify broad trends and determine whether a potential risk may exist.

Generally, information is limited concerning the toxicity of the COCs at Point Lonely and how they relate to the representative species of plants. As a result, when comparisons of TRVs for site-specific species and chemicals are not possible, comparisons of related chemicals with other plant species are made.

As seen in Table 3-19, the concentrations of iron and manganese in the surface water at Point Lonely are both below the reported toxicity values. The risks posed to plants by VOCs, including DRPH, GRPH, benzene, tetrachloroethene, and xylenes, are not expected to be significant. Toxicity values for vascular plants were not available in the literature, but VOCs are not expected to be present at significant levels in most plants because of their volatility, absorption to soil particles, metabolism, or degradation rates in soil (Kostecki and Calabrese 1989). Based on the discussions above, the overall risk to plants from COCs at the Point Lonely sites is not significant.

3.4.2 Potential Risks to Representative Species of Aquatic Organisms

Estimates of exposure for aquatic organisms are based on the average concentrations of each COC in surface water samples (Section 3.1). The HQs for aquatic organisms are presented in Table 3-20. The HQs are calculated by dividing the estimated exposure concentration by the TRV. The following paragraph summarizes the potential risks to aquatic organisms from iron, manganese, GRPH, and tetrachloroethene, the two COCs identified in surface water.

The HQs for iron, manganese, GRPH, and tetrachloroethene in surface water were below 1.0 for *Daphnia* spp. and the nine-spined stickleback. GRPH were evaluated using toxicity data for

TABLE 3-20. HAZARD QUOTIENTS FOR REPRESENTATIVE SPECIES OF AQUATIC ORGANISMS AT THE POINT LONELY INSTALLATION

SPECIES	ESTIMATED EXPOSURE CONCENTRATION (µg/liter)	TRV (µg/liter)	HAZARD QUOTIENT
IRON			
Daphnia spp.	3,000	4,400	0.7
nine-spined stickleback	3,000	4,392	0.7
MANGANESE			
Daphnia spp.	620	1,100	0.6
nine-spined stickleback	620	885	0.7
GRPH			
Daphnia spp.	140	280	0.5
nine-spined stickleback	140	965	0.2
TETRACHLOROETHENE			
Daphnia spp.	230	443	0.5
nine-spined stickleback	230	535	0.4

DRPH because toxicity data for GRPH was not available for aquatic organisms. The chemicals that drive the toxicity of DRPH are often the same as those found in GRPH. These HQs indicate that potential risks to aquatic organisms are not significant at the Point Lonely installation.

3.4.3 Potential Risks to Representative Species of Birds

The HQs for the avian representative species were less than 1.0 for all the COCs that were quantified. HQs were not calculated for benzene because no toxicity information was available for avian species; however, a qualitative discussion comparing avian and mammalian toxicity follows. The avian (and mammalian) HQs are presented in Table 3-21.

Quantitative evaluations of GRPH (although a surrogate evaluation, resulting in a HQ of less than one, was done using the DRPH toxicity information), benzene, and tetrachloroethene were not possible because avian toxicity studies for these COCs were not available. A discussion of the relative toxicity of these chemicals provides a basis for making qualitative statements concerning their toxicity to avian species. Smith (1987) provides the following ranking of relative toxicities based on median lethal doses (LD_{50}s).

TABLE 3-21. HAZARD QUOTIENTS FOR REPRESENTATIVE BIRDS AND MAMMALS AT THE POINT LONELY INSTALLATION

CHEMICAL OF CONCERN	ESTIMATED EXPOSURE (mg/kg-bw/day)	TRV (mg/kg-bw/day)	HAZARD QUOTIENT
IRON			
Lapland longspur	3×10^{-1}	55	5×10^{-3}
brant	6×10^{-2}	15	4×10^{-3}
glaucous gull	1×10^{-2}	14	7×10^{-4}
pectoral sandpiper	4×10^{-1}	38	1×10^{-2}
spectacled eider	3×10^{-3}	15	2×10^{-4}
brown lemming	2×10^{-1}	42	5×10^{-3}
arctic fox	5×10^{-3}	9	6×10^{-4}
caribou	2×10^{-3}	9	2×10^{-4}
MANGANESE			
Lapland longspur	6×10^{-2}	20	3×10^{-3}
brant	1×10^{-2}	5	3×10^{-3}
glaucous gull	2×10^{-3}	5	4×10^{-4}
pectoral sandpiper	8×10^{-2}	14	6×10^{-3}
spectacled eider	6×10^{-4}	5	1×10^{-4}
brown lemming	4×10^{-2}	780	5×10^{-5}
arctic fox	1×10^{-3}	170	6×10^{-6}
caribou	4×10^{-4}	17	2×10^{-5}
DRPH			
Lapland longspur	1×10^{0}	520	2×10^{-3}
brant	6×10^{-1}	140	5×10^{-3}
glaucous gull	9×10^{-2}	140	7×10^{-4}
pectoral sandpiper	1×10^{1}	360	3×10^{-2}
spectacled eider	4×10^{-2}	140	3×10^{-4}
brown lemming	7×10^{0}	310	2×10^{-2}
arctic fox	1×10^{-2}	68	2×10^{-4}

TABLE 3-21. HAZARD QUOTIENTS FOR REPRESENTATIVE BIRDS AND MAMMALS AT THE POINT LONELY INSTALLATION (CONTINUED)

CHEMICAL OF CONCERN	ESTIMATED EXPOSURE (mg/kg-bw/day)	TRV (mg/kg-bw/day)	HAZARD QUOTIENT
caribou	2×10^{-3}	25	8×10^{-5}
GRPH			
Lapland longspur	1×10^{-2}	NA	NC
brant	3×10^{-3}	NA	NC
glaucous gull	5×10^{-4}	NA	NC
pectoral sandpiper	2×10^{-2}	NA	NC
spectacled eider	1×10^{-4}	NA	NC
brown lemming	9×10^{-3}	42	2×10^{-4}
arctic fox	2×10^{-4}	9	3×10^{-5}
caribou	9×10^{-5}	3	4×10^{-6}
BENZENE			
Lapland longspur	3×10^{-3}	NA	NC
brant	2×10^{-4}	NA	NC
glaucous gull	3×10^{-5}	NA	NC
pectoral sandpiper	2×10^{-2}	NA	NC
spectacled eider	4×10^{-5}	NA	NC
brown lemming	2×10^{-2}	10	2×10^{-3}
arctic fox	3×10^{-6}	2	1×10^{-6}
caribou	8×10^{-7}	1	3×10^{-7}
TETRACHLOROETHENE			
Lapland longspur	3×10^{-2}	NA	NC
brant	5×10^{-3}	NA	NC
glaucous gull	8×10^{-4}	NA	NC
pectoral sandpiper	9×10^{-2}	NA	NC
spectacled eider	4×10^{-4}	NA	NC
brown lemming	9×10^{-2}	0.53	2×10^{-1}

TABLE 3-21. HAZARD QUOTIENTS FOR REPRESENTATIVE BIRDS AND MAMMALS AT THE POINT LONELY INSTALLATION (CONTINUED)

CHEMICAL OF CONCERN	ESTIMATED EXPOSURE (mg/kg-bw/day)	TRV (mg/kg-bw/day)	HAZARD QUOTIENT
arctic fox	4×10^{-4}	0.12	3×10^{-3}
caribou	2×10^{-4}	0.05	3×10^{-3}
XYLENES (total)			
Lapland longspur	7×10^{-3}	25	3×10^{-4}
brant	6×10^{-4}	7	9×10^{-5}
glaucous gull	7×10^{-5}	7	1×10^{-5}
pectoral sandpiper	5×10^{-2}	18	3×10^{-3}
spectacled eider	1×10^{-4}	6	2×10^{-5}
brown lemming	6×10^{-2}	179	3×10^{-4}
arctic fox	8×10^{-6}	40	2×10^{-7}
caribou	2×10^{-6}	15	1×10^{-7}

NA = Toxicity data are not available.
NC = Not Calculated.

I. Extremely toxic (LD_{50} ≤40 mg/kg)
II. Highly toxic (LD_{50} 41 - 200 mg/kg)
III. Moderately toxic (LD_{50} 201 - 1,000 mg/kg)
IV. Slightly toxic (LD_{50} 1,001 - 5,000 mg/kg)
V. Relatively nontoxic (LD_{50} >5,000 mg/kg)

Table 3-22 shows the relative toxicity rankings of GPRH, benzene, and tetrachloroethene, based on Smith (1987).

Using the relative toxicities of these COCs, the exposure estimates for avian and mammalian species, and the HQs that were calculated for mammalian species (see Table 3-21 for exposure estimates and HQs), it is possible to make inferences concerning the potential risk to avian species.

There is limited information available on the relative toxicologic sensitivities of birds compared to mammals. Based upon a review of the species and chemicals tested (Smith 1987; Hudson et al. 1979; Tucker and Leitzke 1979), it appears in general that avian and mammalian sensitivities (via oral exposure) fall within the same range, with birds being slightly more sensitive than mammals. There are, of course, exceptions to this general observation, and for a number of chemicals mammals are more sensitive than birds. For cases where birds are more sensitive, most avian toxicity values fall well within one order of magnitude of the mammalian toxicity values.

As noted, avian toxicity values are not available for some COCs in this ERA. However, based on the information presented above, these chemicals are not expected to be significantly more toxic to birds than to mammals. Birds are not expected to be at risk given that there are no HQs for GRPH, benzene, or tetrachloroethene above 1.0 for mammals, and the estimated exposures for birds are sufficiently lower than those for mammals to offset the possibility that some birds may be more sensitive than mammals to these selected COCs. This qualitative discussion and the inter-taxa toxicity estimates introduce additional elements of uncertainty to the risk assessment. See Section 3.5, Uncertainty Analysis, for more discussion of this topic. Based on the above discussions and the HQs presented in Table 3-21, the risk estimates for the avian representative species at the Point Lonely installation are not significant.

3.4.4 Potential Risks to Representative Species of Mammals

HQs for the brown lemming, arctic fox, and the barren-ground caribou are below 1.0 for all COCs. The estimated exposures, TRVs, and HQs are presented in Table 3-21. Based on the calculated HQs, the risk estimates for mammals at the Point Lonely installation are not significant.

3.4.5 Potential Future Risks

Estimates of future risk at the Point Lonely installation are based on the assumption that the gravel pads will remain in place and that the sites are currently and will remain suitable habitat for the representative species. Future risks related to all the COCs at all of the potentially contaminated sites are expected to be as low as, or lower than, current risks (i.e., not significant)

TABLE 3-22. RELATIVE TOXICITY RANKINGS FOR COMPARISON OF MAMMALIAN AND AVIAN TOXICITY

COC	STUDY TYPE	DOSE mg/kg/day	RELATIVE TOXICITY
GRPH	oral rat LD_{50}	14,063[a]	relatively nontoxic
benzene	oral rat LD_{50}	3,400[b]	slightly toxic
tetrachloroethene	oral rat LD_{50}	8,850[b]	relatively nontoxic

a ATSDR 1993b.
b Sax and Lewis 1989.

because the exposure pathways are not likely to change, and the concentrations of COCs are likely to diminish over time.

3.5 ECOLOGICAL RISK ASSESSMENT UNCERTAINTY ANALYSIS

As with any risk assessment, there is great uncertainty associated with the estimates of ecological risk for the sites at the Point Lonely installation. The risk estimates are based on a number of assumptions regarding exposure and toxicity. In general, the primary sources of uncertainty are the following:

- Environmental Sampling and Analysis;
- Selection of COCs;
- Selection of Representative Species;
- Exposure Parameter Estimation; and
- Toxicological Data.

A complete understanding of the uncertainties associated with risk estimates is critical to placing the predicted risks in proper perspective. The most significant sources of uncertainty associated with the estimates of risk for the Point Lonely installation sites are summarized in the following sections.

3.5.1 Environmental Sampling and Analysis

The principal source of uncertainty in the analytical data (for the ERA) stems from the sampling approach and the subsequent calculation of exposure concentrations. Sampling at the Point Lonely installation was conducted in a systematic manner, designed to characterize localized contaminated areas or "hot spots". Therefore, the average concentrations of COCs tend to be biased high because sampling was generally concentrated in areas of the installation where

significant contamination exists or was suspected. In order to partially compensate for this non-random sampling methodology in the calculation of exposure concentrations, the exposure assessment used the average concentration of COCs across the site.

The methods of calculating the average concentrations were the same for organic and inorganic data. In calculating the average concentration of chemicals at the site, non-detected chemicals were entered at one-half of the quantitation limit, as per EPA guidance (EPA 1989a). The use of total metal concentrations in surface water to estimate risk is a conservative approach because dissolved metal concentrations are generally significantly less than total metal concentrations. Therefore, the average concentrations of total metals used to estimate exposure in surface water may overestimate potential risk.

In addition, the sample quantitation limits for several metals were higher than the action levels used to screen the chemicals. Therefore, non-detected concentrations of beryllium, cadmium, copper, chromium, lead, selenium, silver, and thallium may be present in quantities sufficient to elicit adverse effects in aquatic organisms. This probably contributes a low level of uncertainty to the overall risk estimate because surface water pathways at the Point Lonely installation are not likely to be significant routes of exposure to representative species other than *Daphnia* spp.

There is uncertainty inherent in using measurements of DRPH, GRPH, and RRPH for risk assessments. The analytical techniques are not specific to petroleum (i.e., they detect other organics, including naturally-occurring ones) (Von Burg 1993). Moreover, the toxicity of these groups of petroleum hydrocarbons is determined by the toxicity of their individual constituents. When petroleum compounds are released to the environment, they tend to weather or transform readily. For example, the lighter fractions (such as BTEX) will volatilize to the atmosphere more readily than the heavier fractions (such as decane, pyrene, or benzo(a)pyrene). The lighter fractions are thought to be the more toxic (Wong et al. 1981; O'Brien 1978; Kauss and Hutchinson 1975; and Soto et al. 1975). Therefore, the toxicity of DRPH, GRPH, and RRPH is expected to change over time depending upon the attenuation mechanisms occurring in the environment. As a result, the toxicity of the petroleum hydrocarbons detected at the Point Lonely sites is unknown. Use of toxicity values reported in the literature probably contributes to an overestimation of the risk because it is likely that the most toxic components of the mixtures detected have volatilized to the atmosphere over time.

3.5.2 Selection of Chemicals for Evaluation

The selection of COCs in the ERA was based upon a comparison to background concentrations and action levels, and an evaluation of the frequency of detection. For certain chemicals, no action levels were available, and action levels for related compounds were used. This introduces some uncertainty into the risk assessment as actual toxicity may be different from the toxicity of the surrogate chemical. Overall, however, the process provided a conservative screen of COCs, and it is unlikely that any chemicals presenting an ecological risk were omitted.

3.5.3 Selection of Representative Species

The selection of representative species in the ERA introduces some uncertainty into the risk estimates. No site-specific biological surveys were conducted at the Point Lonely installation, with the exception of a survey for spectacled and Steller's eiders (Alaska Biological Research 1994). As a result, it is not known whether or how often the representative species are actually found at the site; however, the uncertainty introduced into the risk estimate by this route is likely to be low. The purpose of ERAs is not to survey the biota at a site, but to estimate the risks to species that may inhabit the area. Surrogate species are commonly used, even if the representative species do not reside specifically at the Point Lonely installation, the risk estimates in this report provide a sound measure of the potential risks to the species that do inhabit the area.

3.5.4 Exposure Assessment

Exposures were estimated using literature-based life history information for the selected representative species. There is moderate uncertainty associated with the exposure information. Food and water ingestion rates were not available for some animals and had to be estimated from regression equations. Incidental ingestion of soils and sediments may occur while animals are foraging, and it is uncertain how much is actually ingested. In addition, there is uncertainty associated with the habitat associated at the site. Samples were collected around buildings and other structures that are likely to provide habitat of limited quality. As a result, this tends to overestimate exposure. Further, there are significant uncertainties associated with the estimates of how extensively a receptor will use the site, which were based on home range information. As noted in the discussion of estimation of percent ingested onsite (Section 3.2.7.2) the conversion of population density values as substitutes for home ranges adds uncertainty to the risk assessment. The conversion was necessary because home range data are lacking for some of the representative species.

There is some uncertainty associated with the diet compositions estimated from the literature. A good example of this type of uncertainty is the unpredictable fluctuation in the populations of the brown lemmings and their predators (i.e., arctic fox, glaucous gull). As the numbers of prey increase, predator populations may experience numerical and density increases well beyond the values reported in the literature. When prey populations decrease, predation pressure can shift to diet items not considered "normal", that do not represent dietary intakes reported in the literature. Wildlife, and their interactions with the environment around them, are dynamic. Stochastic events, natural or anthropogenic, may cause behavior and/or habits to differ markedly from the "expected or norm". Deviations from typical behavior cause uncertainty when evaluating wildlife and ecosystems.

There is uncertainty associated with exposure estimates for plants. Plant uptake of COCs was derived from a regression equation using the K_{ow} of the COC (Table 3-5). This calculation estimates the concentration of chemicals in the vegetative portion of plants. Actual concentrations of the COC in plant tissue will vary depending upon actual chemical uptake, species of plant, and other site-specific factors (such as soil organic carbon). It is important to note that screening level tissue concentrations in plants were not available for comparison with

these estimated concentrations. The overall effect of this source of uncertainty in the risk assessment is low, as is the ecological risk to plants.

The only component in the diet of representative species evaluated quantitatively was the ingestion of plants. Ingestion of animal prey (e.g., the diet of the arctic fox and the insectivorous portion of some avian diets) was not quantified. This may slightly underestimate risk for species that rely on animal items in their diet.

3.5.5 Toxicological Data

One of the largest sources of uncertainty in risk assessment is from the toxicological data. Often there are not relevant studies for the specific representative species or endpoints. As a result, extrapolations are made, which introduce uncertainty into the risk estimate. These extrapolations incorporate UF into the calculation of TRVs. The purpose of the UF is to incorporate some margin of error into the risk estimate, in order to arrive at a "safe" level of exposure to which onsite exposure concentrations may be compared. These techniques introduce into the risk assessment a tendency to overestimate rather than underestimate the risk, as conservative estimates were made in estimating toxicity values.

For some chemicals, no toxicity information was available (e.g., avian toxicity values for GRPH, benzene, and tetrachloroethene). As a result, these compounds were not evaluated quantitatively in the risk assessment, and the risk may be somewhat underestimated. Based on the low concentrations and low frequency of detection of these compounds (as discussed in Section 3.1), the uncertainty associated with this factor is low.

Toxicity values for plants, water, soils, and sediments are based on literature values. Toxicity in soils and sediments is affected by the bioavailability of a given chemical. Toxicity of metals in water is based, in part, upon the speciation of the element. As a result, site-specific bioavailability or toxicity may differ from that in the studies used to estimate potential toxic effects. Therefore, actual toxicity of chemicals at the Point Lonely sites may be different from the values reported in the literature. In addition, the sensitivity of receptors on site may be different from the sensitivity of the species reported in the literature.

There is a great deal of uncertainty in assessing the toxicity of a mixture of chemicals. In this ERA, the effects of exposure from each contaminant have been considered separately. These substances occur together at the site, however, and organisms may be exposed to mixtures of the chemicals. Prediction of how these mixtures of toxicants will interact must be based on an understanding of the mechanisms of such interactions. Interactions of the individual components of chemical mixtures may occur during absorption, distribution, metabolism, excretion, or activity at the receptor site. Individual compounds may interact chemically, yielding a new toxic component or causing a change in the biological availability of an existing component, or may interact by causing different effects at different receptor sites. Suitable data are not currently available to characterize the effects of chemical mixtures rigorously, so chemicals present at the site were evaluated independently. This approach of assessing risk associated with mixtures of chemicals does not account for any additive, synergistic, or antagonistic interactions among the

chemicals considered. However, as discussed in Section 3.6, the risk assessment yielded a low potential for ecological risks, and it is unlikely that additive effects of chemicals are a concern.

3.6 SUMMARY OF ECOLOGICAL RISK

The potential risks to ecological receptors are summarized in this section based on the information presented in Sections 3.1 through 3.4. The reader is referred to these sections for more details on the assessment. Conclusions regarding potential risks must be viewed in the context of the uncertainties associated with the assessment (Section 3.5) and the available risk information. The available risk information includes chemical data, exposure estimates, and literature-based toxicity information. Table 3-23 summarizes the ecological risks at the sites evaluated at the Point Lonely installation.

3.6.1 Potential Risks to Representative Plants

A qualitative comparison was conducted of onsite soil/sediment and surface water COC concentrations with plant toxicity information. The risk to plants is characterized by using comparative information from the literature and BCF (B_v). Based on the qualitative comparison, the risks to plants are not significant.

TABLE 3-23. SUMMARY OF ECOLOGICAL RISK ESTIMATES AT THE POINT LONELY SITES

SITE	COC CONTRIBUTING TO RISK	CURRENT RISK POTENTIAL	FUTURE RISK POTENTIAL
Sewage Disposal Area SS01	None	not significant	not significant
Drum Storage Area ST02	None	not significant	not significant
Beach Diesel Tanks SS03	None	not significant	not significant
POL Storage SS04	None	not significant	not significant
Diesel Spills SS05	None	not significant	not significant
Old Dump Site LF07	None	not significant	not significant
Garage SS09	None	not significant	not significant
Diesel Tank ST10	None	not significant	not significant
Inactive Landfill LF11/Vehicle Storage Area SS14	None	not significant	not significant
Module Train SS12	None	not significant	not significant
Hangar Pad Area SS13	None	not significant	not significant

3.6.2 Potential Risks to Representative Aquatic Species

Potential risks to aquatic species were evaluated by comparing toxicity information from the literature with the average exposure concentrations of potential contaminants in surface water.

Considering site and COC-specific factors, the overall risk to aquatic organisms at the Point Lonely installation is not considered significant.

3.6.3 Potential Risks to Representative Species of Birds and Mammals

The risks to representative species of birds and mammals were evaluated using the quotient method. This method compares the estimated exposures with TRVs, resulting in a calculated HQ. In some cases, HQs were not calculated for avian species because of the lack of COC-specific toxicity information; they were evaluated using a qualitative comparison with the mammalian toxicities in Section 3.4.3, Risk Characterization. The resulting risk estimates for all of the avian and mammalian representative species were not significant. In addition, the risks resulting from potential future exposure to COCs at the Point Lonely installation are estimated to be as low as, or lower than, the current estimates (i.e., not significant).

3.6.4 Summary of Potential Ecological Risks

The objective of this ERA is to evaluate the potential risk to the representative plant, aquatic, and terrestrial species at the Point Lonely DEW Line installation. The assessment indicates that the potential ecological risks currently presented by the COCs at the Point Lonely sites are not significant.

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APPENDIX A

RISK CHARACTERIZATION SPREADSHEETS

TABLE A-1. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route:	Soil Ingestion
Endpoint:	Noncancer
Assumptions:	Site-specific
Installation:	Point Lonely
Site:	Sewage Disposal Area (SS01)
File:	SS01SONC.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	14	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(ED x 365 days/year)	3,650	17,885	2,190

Chemical	Oral RfD	Concentration Soil (mg/kg)	ADD by Receptor Group (mg/kg-day)			Hazard Quotients	
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
DRPH	0.08	16,000	4.38e-04	1.88e-03	1.75e-02	5.48e-03	2.43e-01
GRPH	0.2	1,000	2.74e-05	1.17e-04	1.10e-03	1.37e-04	6.07e-03
					HAZARD INDEX	0.006	0.249

TABLE A-2. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route:	Soil Ingestion
Endpoint:	Cancer
Assumptions:	Site-specific
Installation:	Point Lonely
Site:	Sewage Disposal Area (SS01)
File:	SS01SOCA.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	14	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(lifetime in days)	25,550	25,550	25,550

Chemical	Carcinogen Oral Slope Factor	Concentration Soil (mg/kg)	LADD by Receptor Group (mg/kg-day)			Cancer Risk	
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
GRPH	0.0017	1,000	3.91e-06	8.22e-05	9.39e-05	6.65e-09	2.99e-07
					CANCER RISK	7e-09	3e-07

TABLE A-3. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route:	Water Ingestion
Endpoint:	Cancer
Assumptions:	Site-specific
Installation:	Point Lonely
Site:	Sewage Disposal Area (SS01)
File:	SS01WACA.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult
Water Ingestion	(L/day)	2	2
Exposure Frequency	(days/year)	14	180
Exposure Duration	(years)	10	55
Conversion Factor	(kg/mg)	1	1
Body Weight	(kg)	70	70
Averaging Time	(lifetime in days)	25,550	25,550

Chemical	Carcinogen Oral Slope Factor	Concentration Water (mg/L)	LADD by Receptor Group (mg/kg-day)		Cancer Risk	
			DEW Line Worker	Native Northern Adult	DEW Line Worker	Native Northern Adult
Benzene	0.029	0.002	3.13e-07	2.21e-05	9.08e-09	6.42e-07
Chloromethane	0.013	0.0066	1.03e-06	7.29e-05	1.34e-08	9.48e-07
				CANCER RISK	2e-08	2e-06

TABLE A-4. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route:	Soil Ingestion
Endpoint:	Noncancer
Assumptions:	Site-specific
Installation:	Point Lonely
Site:	Drum Storage Area (ST02)
File:	ST02SONC.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	14	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(ED x 365 days/year)	3,650	17,885	2,190

Chemical	Oral RfD	Concentration Soil (mg/kg)	ADD by Receptor Group (mg/kg-day)			Hazard Quotients	
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
DRPH	0.08	1,000	2.74e-05	1.17e-04	1.10e-03	3.42e-04	1.52e-02
Tetrachloroethene	0.01	2	5.48e-08	2.35e-07	2.19e-06	5.48e-06	2.43e-04
					HAZARD INDEX	<0.001	0.015

TABLE A-5. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Soil Ingestion
Endpoint: Cancer
Assumptions: Site-specific
Installation: Point Lonely
Site: Drum Storage Area (ST02)
File: ST02SOCA.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	14	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(lifetime in days)	25,550	25,550	25,550

Chemical	Carcinogen Oral Slope Factor	Concentration Soil (mg/kg)	LADD by Receptor Group (mg/kg-day)			Cancer Risk	
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
Tetrachloroethene	0.052	2	7.83e-09	1.64e-07	1.88e-07	4.07e-10	1.83e-08
					CANCER RISK	4e-10	2e-08

TABLE A-6. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route:	Water Ingestion
Endpoint:	Noncancer
Assumptions:	Site-specific
Installation:	Point Lonely
Site:	Drum Storage Area (ST02)
File:	ST02WANC.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult
Water Ingestion	(L/day)	2	2
Exposure Frequency	(days/year)	14	180
Exposure Duration	(years)	10	55
Conversion Factor	(kg/mg)	1	1
Body Weight	(kg)	70	70
Averaging Time	(ED x 365 days/year)	3,650	20,075

Chemical	Oral RfD	Concentration Water (mg/L)	ADD by Receptor Group (mg/kg-day)		Hazard Quotient	
			DEW Line Worker	Native Northern Adult	DEW Line Worker	Native Northern Adult
Toluene	0.2	1.5	1.64e-03	2.11e-02	8.22e-03	1.06e-01
				HAZARD INDEX	8.22e-03	1.06e-01

TABLE A-7. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Water Ingestion
Endpoint: Cancer
Assumptions: Site-specific
Installation: Point Lonely
Site: Drum Storage Area (ST02)
File: ST02WACA.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult
Water Ingestion	(L/day)	2	2
Exposure Frequency	(days/year)	14	180
Exposure Duration	(years)	10	55
Conversion Factor	(kg/mg)	1	1
Body Weight	(kg)	70	70
Averaging Time	(lifetime in days)	25,550	25,550

Chemical	Carcinogen Oral Slope Factor	Concentration Water (mg/L)	LADD by Receptor Group (mg/kg-day)		Cancer Risk	
			DEW Line Worker	Native Northern Adult	DEW Line Worker	Native Northern Adult
Benzene	0.029	0.5	7.83e-05	5.54e-03	2.27e-06	2.04e-04
				CANCER RISK	2e-06	2e-04

TABLE A-8. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Soil Ingestion
Endpoint: Noncancer
Assumptions: Site-specific
Installation: Point Lonely
Site: Beach Diesel Tank (SS03)
File: SS03SONC.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	14	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(ED x 365 days/year)	3,650	17,885	2,190

Chemical	Oral RfD	Concentration Soil (mg/kg)	ADD by Receptor Group (mg/kg-day)			Hazard Quotients	
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
DRPH	0.08	15,200	4.16e-04	1.78e-03	1.67e-02	5.21e-03	2.31e-01
GRPH	0.2	150	4.11e-06	1.76e-05	1.64e-04	2.05e-05	9.10e-04
					HAZARD INDEX	0.005	0.231

TABLE A-9. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Soil Ingestion
Endpoint: Cancer
Assumptions: Site-specific
Installation: Point Lonely
Site: Beach Diesel Tank (SS03)
File: SS03SOCA.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	14	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(lifetime in days)	25,550	25,550	25,550

Chemical	Carcinogen Oral Slope Factor	Concentration Soil (mg/kg)	LADD by Receptor Group (mg/kg-day)			Cancer Risk	
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
GRPH	0.0017	150	5.87e-07	1.23e-05	1.41e-05	9.98e-10	4.49e-08
					CANCER RISK	1e-09	4e-08

TABLE A-10. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Soil Ingestion
Endpoint: Noncancer
Assumptions: Site-specific
Installation: Point Lonely
Site: POL Storage (SS04)
File: SS04SONC.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	14	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(ED x 365 days/year)	3,650	17,885	2,190

Chemical	Oral RfD	Concentration Soil (mg/kg)	ADD by Receptor Group (mg/kg-day)			Hazard Quotients	
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
Tetrachloroethene	0.01	6.7	1.84e-07	7.87e-07	7.34e-06	1.84e-05	8.13e-04
					HAZARD INDEX	<0.001	0.001

TABLE A-11. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Soil Ingestion
Endpoint: Cancer
Assumptions: Site-specific
Installation: Point Lonely
Site: POL Storage (SS04)
File: SS04SOCA.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	14	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(lifetime in days)	25,550	25,550	25,550

Chemical	Carcinogen Oral Slope Factor	Concentration Soil (mg/kg)	LADD by Receptor Group (mg/kg-day)			Cancer Risk	
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
Benzene	0.029	1.6	6.26e-09	1.32e-07	1.50e-07	1.82e-10	8.17e-09
Tetrachloroethene	0.052	6.7	2.62e-08	5.51e-07	6.29e-07	1.36e-09	6.14e-08
Trichloroethene	0.011	24	4.38e-08	1.97e-06	6.29e-07	1.03e-09	2.17e-08
					CANCER RISK	4e-09	9e-08

TABLE A-12. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Water Ingestion
Endpoint: Noncancer
Assumptions: Site-specific
Installation: Point Lonely
Site: POL Storage (SS04)
File: SS04WANC.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult
Water Ingestion	(L/day)	2	2
Exposure Frequency	(days/year)	14	180
Exposure Duration	(years)	10	55
Conversion Factor	(kg/mg)	1	1
Body Weight	(kg)	70	70
Averaging Time	(ED x 365 days/year)	3,650	20,075

Chemical	Oral RfD	Concentration Water (mg/L)	ADD by Receptor Group (mg/kg-day)		Hazard Quotient	
			DEW Line Worker	Native Northern Adult	DEW Line Worker	Native Northern Adult
GRPH	0.2	3	3.29e-03	4.23e-02	1.64e-02	2.11e-01
cis-1,2-Dichloroethene	0.01	1.02	1.12e-03	1.44e-02	1.12e-01	1.44e+00
Methylene Chloride	0.06	0.161	1.76e-04	2.27e-03	2.94e-03	3.78e-02
Tetrachloroethene	0.01	1.83	2.01e-03	2.58e-02	2.01e-01	2.58e+00
Toluene	0.2	1.22	1.34e-03	1.69e-02	6.68e-03	8.45e-02

TABLE A-12. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET (CONTINUED)

Chemical	Oral RfD	Concentration Water (mg/L)	ADD by Receptor Group (mg/kg-day)		Hazard Quotient	
			DEW Line Worker	Native Northern Adult	DEW Line Worker	Native Northern Adult
4-Methylphenol	0.005	0.11	1.21e-04	1.55e-03	2.41e-02	3.10e-01
Barium	0.07	0.34	3.73e-04	4.79e-03	5.32e-03	6.84e-02
Manganese	0.005	3.1	3.40e-03	4.37e-02	6.79e+01	8.74e+00
				HAZARD INDEX	1.05e+00	1.35e+01

TABLE A-13. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route:	Water Ingestion
Endpoint:	Cancer
Assumptions:	Site-specific
Installation:	Point Lonely
Site:	POL Storage (SS04)
File:	SS04WACA.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult
Water Ingestion	(L/day)	2	2
Exposure Frequency	(days/year)	14	180
Exposure Duration	(years)	10	55
Conversion Factor	(kg/mg)	1	1
Body Weight	(kg)	70	70
Averaging Time	(lifetime in days)	25,550	25,550

Chemical	Carcinogen Oral Slope Factor	Concentration Water (mg/L)	LADD by Receptor Group (mg/kg-day)		Cancer Risk	
			DEW Line Worker	Native Northern Adult	DEW Line Worker	Native Northern Adult
GRPH	0.0017	3	4.70e-04	3.32e-02	7.98e-07	5.65e-05
Benzene	0.029	0.23	3.60e-05	6.22e-03	1.04e-06	1.80e-04
Methylene Chloride	0.0075	0.161	2.52e-08	1.78e-03	1.89e-07	1.34e-05
Tetrachloroethene	0.052	1.83	2.86e-04	2.03e-02	1.49e-05	1.05e-03
Trichloroethene	0.11	0.285	4.46E-05	3.16e-03	4.91e-06	3.47e-04
				CANCER RISK	2e-06	2e-03

TABLE A-14. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Soil Ingestion
Endpoint: Noncancer
Assumptions: Site-specific
Installation: Point Lonely
Site: Diesel Spill (SS05)
File: SS05SONC.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	14	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(ED x 365 days/year)	3,650	17,885	2,190

Chemical	Oral RfD	Concentration Soil (mg/kg)	ADD by Receptor Group (mg/kg-day)			Hazard Quotients	
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
DRPH	0.08	4,300	1.18e-04	5.05e-04	4.71e-03	1.47e-03	6.52e-02
GRPH	0.2	120	3.29e-06	1.41e-05	1.32e-04	1.64e-05	7.28e-04
					HAZARD INDEX	0.001	0.066

TABLE A-15. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route:	Soil Ingestion
Endpoint:	Cancer
Assumptions:	Site-specific
Installation:	Point Lonely
Site:	Diesel Spill (SS05)
File:	SS05SOCA.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	14	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(lifetime in days)	25,550	25,550	25,550

Chemical	Carcinogen Oral Slope Factor	Concentration Soil (mg/kg)	LADD by Receptor Group (mg/kg-day)			Cancer Risk	
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
GRPH	0.0017	120	4.70e-07	9.86e-06	1.13e-05	7.98e-10	3.59e-08
Benzene	0.029	1.2	4.70e-09	9.86e-08	1.13e-07	1.36e-10	6.13e-09
					CANCER RISK	9e-10	4e-08

TABLE A-16. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route:	Water Ingestion
Endpoint:	Noncancer
Assumptions:	Site-specific
Installation:	Point Lonely
Site:	Diesel Spill (SS05)
File:	SS05WANC.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult
Water Ingestion	(L/day)	2	2
Exposure Frequency	(days/year)	14	180
Exposure Duration	(years)	10	55
Conversion Factor	(kg/mg)	1	1
Body Weight	(kg)	70	70
Averaging Time	(ED x 365 days/year)	3,650	20,075

Chemical	Oral RfD	Concentration Water (mg/L)	ADD by Receptor Group (mg/kg-day)		Hazard Quotient	
			DEW Line Worker	Native Northern Adult	DEW Line Worker	Native Northern Adult
GRPH	0.2	0.24	2.63e-04	3.38e-03	1.32e-03	1.69e-02
				HAZARD INDEX	1.32e-03	1.69e-02

TABLE A-17. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route:	Water Ingestion
Endpoint:	Cancer
Assumptions:	Site-specific
Installation:	Point Lonely
Site:	Diesel Spill (SS05)
File:	SS05WACA.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult
Water Ingestion	(L/day)	2	2
Exposure Frequency	(days/year)	180	180
Exposure Duration	(years)	10	55
Conversion Factor	(kg/mg)	1	1
Body Weight	(kg)	70	70
Averaging Time	(lifetime in days)	25,550	25,550

Chemical	Carcinogen Oral Slope Factor	Concentration Water (mg/L)	LADD by Receptor Group (mg/kg-day)		Cancer Risk	
			DEW Line Worker	Native Northern Adult	DEW Line Worker	Native Northern Adult
GRPH	0.0017	0.24	4.83e-04	2.66e-03	8.21e-07	4.52e-06
Benzene	0.029	0.021	4.23e-05	2.32e-04	1.23e-06	6.74e-06
Chloromethane	0.013	0.0023	3.60e-07	2.58e-05	4.68e-09	3.31e-07
				CANCER RISK	2e-06	1e-05

TABLE A-18. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Soil Ingestion
Endpoint: Noncancer
Assumptions: Site-specific
Installation: Point Lonely
Site: Old Dump Site (LF07)
File: LF07SONC.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	14	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(ED x 365 days/year)	3,650	17,885	2,190

Chemical	Oral RfD	Concentration Soil (mg/kg)	ADD by Receptor Group (mg/kg-day)			Hazard Quotients	
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
RRPH	0.08	5,900	1.62e-04	6.93e-04	6.47e-03	2.02e-03	8.95e-02
					HAZARD INDEX	0.002	0.089

TABLE A-19. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route:	Soil Ingestion
Endpoint:	Noncancer
Assumptions:	Site-specific
Installation:	Point Lonely
Site:	Garage (SS09)
File:	SS09SONC.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	14	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(ED x 365 days/year)	3,650	17,885	2,190

Chemical	Oral RfD	Concentration Soil (mg/kg)	ADD by Receptor Group (mg/kg-day)			Hazard Quotients	
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
DRPH	0.08	16,000	4.38e-04	1.88e-03	1.75e-02	5.48e-03	2.43e-01
GRPH	0.2	400	1.10e-05	4.70e-05	4.38e-04	5.48e-05	2.43e-03
RRPH	0.08	10,000	2.74e-04	1.17e-03	1.10e-02	3.42e-03	1.52e-01
Tetrachloroethene	0.01	18	4.93e-07	2.11e-06	1.97e-05	4.93e-05	2.18e-03
					HAZARD INDEX	0.009	0.399

TABLE A-20. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route:	Soil Ingestion
Endpoint:	Cancer
Assumptions:	Site-specific
Installation:	Point Lonely
Site:	Garage (SS09)
File:	SS09SOCA.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	14	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(lifetime in days)	25,550	25,550	25,550

Chemical	Carcinogen Oral Slope Factor	Concentration Soil (mg/kg)	LADD by Receptor Group (mg/kg-day)			Cancer Risk	
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
GRPH	0.0017	400	1.57e-06	3.29e-05	3.76e-05	2.66e-09	1.20e-07
Tetrachloroethene	0.052	18	7.05e-08	1.48e-06	1.69e-06	3.66e-09	1.65e-07
					CANCER RISK	6e-09	3e-07

TABLE A-21. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Water Ingestion
Endpoint: Noncancer
Assumptions: Site-specific
Installation: Point Lonely
Site: Garage (SS09)
File: SS09WANC.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult
Water Ingestion	(L/day)	2	2
Exposure Frequency	(days/year)	14	180
Exposure Duration	(years)	10	55
Conversion Factor	(kg/mg)	1	1
Body Weight	(kg)	70	70
Averaging Time	(ED x 365 days/year)	3,650	20,075

Chemical	Oral RfD	Concentration Water (mg/L)	ADD by Receptor Group (mg/kg-day)		Hazard Quotient	
			DEW Line Worker	Native Northern Adult	DEW Line Worker	Native Northern Adult
Barium	0.07	0.29	3.18e-06	4.09e-03	4.54e-03	5.84e-02
				HAZARD INDEX	4.54e-03	5.84e-02

TABLE A-22. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Water Ingestion
Endpoint: Cancer
Assumptions: Site-specific
Installation: Point Lonely
Site: Garage (SS09)
File: SS09WACA.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult
Water Ingestion	(L/day)	2	2
Exposure Frequency	(days/year)	14	180
Exposure Duration	(years)	10	55
Conversion Factor	(kg/mg)	1	1
Body Weight	(kg)	70	70
Averaging Time	(lifetime in days)	25,550	25,550

Chemical	Carcinogen Oral Slope Factor	Concentration Water (mg/L)	LADD by Receptor Group (mg/kg-day)		Cancer Risk	
			DEW Line Worker	Native Northern Adult	DEW Line Worker	Native Northern Adult
Benzene	0.029	0.002	3.13e-07	2.21e-05	9.08e-09	6.42e-07
				CANCER RISK	9e-09	6e-07

TABLE A-23. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Soil Ingestion
Endpoint: Noncancer
Assumptions: Site-specific
Installation: Point Lonely
Site: Diesel Tank (ST10)
File: ST10SONC.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	14	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(ED x 365 days/year)	3,650	17,885	2,190

Chemical	Oral RfD	Concentration Soil (mg/kg)	ADD by Receptor Group (mg/kg-day)			Hazard Quotients	
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
DRPH	0.08	900	2.47e-05	1.06e-04	9.86e-04	3.08e-04	1.36e-02
GRPH	0.2	380	1.04e-05	4.46e-05	4.16e-04	5.21e-05	2.31e-03
					HAZARD INDEX	<0.001	0.016

TABLE A-24. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Soil Ingestion
Endpoint: Cancer
Assumptions: Site-specific
Installation: Point Lonely
Site: Diesel Tank (ST10)
File: ST10SOCA.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult	Native Northern Child
Soil Ingestion Rate	(mg/day)	50	100	200
Exposure Frequency	(days/year)	14	30	30
Exposure Duration	(years)	10	49	6
Conversion Factor	(kg/mg)	0.000001	0.000001	0.000001
Body Weight	(kg)	70	70	15
Averaging Time	(lifetime in days)	25,550	25,550	25,550

Chemical	Carcinogen Oral Slope Factor	Concentration Soil (mg/kg)	LADD by Receptor Group (mg/kg-day)			Cancer Risk	
			DEW Line Worker	Native Northern Adult	Native Northern Child	DEW Line Worker	Native Northern Adult/Child
GRPH	0.0017	380	1.49e-06	3.12e-05	3.57e-05	2.53e-09	1.14e-07
					CANCER RISK	3e-09	1e-07

TABLE A-25. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route: Water Ingestion
Endpoint: Noncancer
Assumptions: Site-specific
Installation: Point Lonely
Site: Inactive Landfill (LF11)
File: LF11WANC.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult
Water Ingestion	(L/day)	2	2
Exposure Frequency	(days/year)	14	180
Exposure Duration	(years)	10	55
Conversion Factor	(kg/mg)	1	1
Body Weight	(kg)	70	70
Averaging Time	(ED x 365 days/year)	3,650	20,075

Chemical	Oral RfD	Concentration Water (mg/L)	ADD by Receptor Group (mg/kg-day)		Hazard Quotient	
			DEW Line Worker	Native Northern Adult	DEW Line Worker	Native Northern Adult
GRPH	0.2	0.2	2.19e-04	2.82e-03	1.10e-03	1.41e-02
Barium	0.07	0.35	3.84e-04	4.93e-03	5.48e-03	7.05e-02
				HAZARD INDEX	6.58e-03	8.45e-02

TABLE A-26. DEW LINE INSTALLATION RISK ASSESSMENT SPREADSHEET

Route:	Water Ingestion
Endpoint:	Cancer
Assumptions:	Site-specific
Installation:	Point Lonely
Site:	Inactive Landfill (LF11)
File:	LF11WACA.WK1

Exposure Assumptions		DEW Line Worker	Native Northern Adult
Water Ingestion	(L/day)	2	2
Exposure Frequency	(days/year)	14	180
Exposure Duration	(years)	10	55
Conversion Factor	(kg/mg)	1	1
Body Weight	(kg)	70	70
Averaging Time	(lifetime in days)	25,550	20,075

Chemical	Carcinogen Oral Slope Factor	Concentration Water (mg/L)	LADD by Receptor Group (mg/kg-day)		Cancer Risk	
			DEW Line Worker	Native Northern Adult	DEW Line Worker	Native Northern Adult
GRPH	0.0017	0.2	6.26e-07	2.21e-03	9.08e-07	3.76e-06
Benzene	0.029	0.004	3.13e-05	4.43e-05	1.06e-09	1.28e-06
				CANCER RISK	9e-07	5e-06

APPENDIX B

TOXICITY PROFILES

TOXICOLOGY PROFILE FOR GASOLINE

GENERAL DATA

The chemical composition of gasoline is extremely variable, depending upon the crude oil starting material, types of processing and refining, blending and additives employed. Gasolines are formulated to meet fuel performance specifications, not to achieve a specific chemical composition. Volatility must be within a certain range to avoid vapor lock (too high) or sluggish acceleration (too low). In addition, the air-fuel mixture within the cylinder must burn uniformly to prevent "pinging" or "knocking." Often small quantities of butanes, pentanes, organo lead compounds or branched chain hydrocarbons are added to achieve uniform burning rates. McDermott and Killiany (1978) published a detailed gas chromatographic analysis of a premium grade gasoline listing 21 components which accounted for 92 percent of the gasoline vapors (Table 1). Low-volatility hydrocarbons (high carbon numbers) were not well represented.

TABLE 1. COMPOSITION OF A PREMIUM-GRADE GASOLINE

COMPOUND	VOL %
Propane	0.8
n-Butane	38.1
Isobutane	5.2
n-Pentane	7.0
Cyclopentane	0.7
2,3-DM-butane	0.7
2-M-pentane	2.1
3-M-pentane	1.6
n-Hexane	1.5
M-cyclopentane	1.3
2,4-DM-pentane	0.4
2,3-DM-pentane	0.7
2,2,4-TM-pentane	0.5
Isobutylene	1.1
2-M-1-butane	1.6
c-2-pentene	1.2
2-M-2-butene	1.7
Benzene	0.7

COMPOUND	VOL %
Toluene	1.8
Xylene (m,p,o)	0.5
Total %	**92.1**

Gasoline additives include organic lead (tetraethyl lead and tetramethyl lead) to a concentration of 0.1 g/gallon (7 ppm). Alkyl lead vapors have low volatility (vapor pressure = 0.4 mm Hg) compared to gasoline (400-775 mm Hg), so lead compounds should not be acutely hazardous by inhalation. To prevent accumulation of lead deposits, scavenging agents are added to fuels: ethylene dichloride (EDC) and ethylene dibromide (EDB), usually in a molar ratio EDC/EDB/Pb = 2:2:1.

FATE AND TRANSPORT

Gasoline released into the environment would be expected to evaporate rapidly due to its high vapor pressure (400-477 mm Hg). Studies of gasoline fate when added to **soils** show that the main clearance mechanism was evaporation which can account for up to 75 percent removal from surface soils (Donaldson 1990). Microbial degradation, plus evaporation, can remove up to 90 percent of the added gasoline (Song 1988). Benzene, a volatile gasoline component of major toxicological interest, has a half life in the **air** of less than 1 day (Korte and Klein 1982). Gasoline has appreciable water solubility (12 to 16 percent) so it would be transported in ground **water** and may be found in well water.

TOXICITY DATA

Human Toxicological Profile

Like other solvents, gasoline has potent central nervous system (CNS) depressant activity. Breathing vapors at concentrations achieved during "huffing" or occupational overexposures has led to a variety of neurological symptoms: hallucinations, encephalopathy, ataxia, convulsions, Tourette's Disease, vertigo and nystagmus and peripheral neuropathy (Von Burg 1989). Many of these symptoms may be attributed to n-hexane or alkyl lead compounds.

Ingestion of gasoline can occur during siphoning, abuse situations or from contaminated well-water. Ingestion is accompanied by a burning sensation in the mouth, pharynx, and chest. Swallowing large amounts of gasoline leads to coma and death by respiratory depression. A serious complication is the aspiration of hydrocarbons into the lung which produces a potentially-lethal hemorrhagic pneumonitis (Lee and Seymour 1979).

Three epidemiologic studies of refinery workers showed no increased cancer risk in refinery workers (Hanis et al. 1982; Kaplan 1986; Wong 1987). In an epidemiological study of refinery workers and gasoline handlers, Thomas et al. (1982), found a significant increase in stomach and brain cancer with a trend to increased leukemia and cancer of the skin, prostate and pancreas.

Animal Toxicology and Significant Studies

The acute dermal LD_{50} of gasoline in rabbits is reported to be <5 ml/kg (Von Burg 1989). Liquid gasoline is considered a primary skin irritant because of repeated contact with skin and the defatting and fissuring which occurs. Hypersensitivity response to gasoline can occur. Dermal absorption of gasoline is unlikely to result in systemic toxicity, but chronic poisoning of the readily absorbable alkyl lead additives is possible. Although acutely irritating to the eye, animal studies indicate no effect lasting longer than seven days.

Inhalation of gasoline vapors in routine dispensing produces low exposures (<5 ppm). However, exposure to concentrations of 1,000 to 5,000 ppm for 15 to 60 minutes can produce CNS depression. A 5-minute exposure to 20,000 ppm (20 percent) has been reported to be fatal (Von Burg 1989).

MacFarland (1982), reported on a chronic inhalation study of gasoline in Fischer 344 rats and $B6C3F_1$ mice. Exposure levels were 0, 67, 292, and 2056 ppm for 6 hours/day, 5 days/week for 103 to 113 weeks. Male (but not female) rats exhibited a progressive renal tubular disease and renal carcinomas in all dose groups; renal effects in mice were within the expected range of control. High dose female mice had an increased incidence of hepatocellular tumors(48 percent), but the spontaneous incidence of these tumors is also high (14 percent); males showed no increase (44 percent high dose vs. control 45 percent).

Reproductive Toxicity

Male rats exposed intermittently to about 650 ppm unleaded petrol for 2 months showed endocrine changes which were attributed to stress. Pregnant females exposed to 0, 400, and 1,600 ppm unleaded gasoline on days 6 to 15 of gestation for 6 hrs/day did not show any teratogenic or fetotoxic effects. Mental retardation has been reported among gasoline sniffing mothers.

Genotoxicity

Several common fuels were found to be negative when tested in the Ames Salmonella typhimurium assay, mouse lymphoma, and the rat bone marrow chromosomal aberration assay (Lebowitz et al. 1979). Unleaded gasoline was unable to induce unscheduled and replicative DNA synthesis in the male rat kidney at doses known to be nephrotoxic.

Carcinogenicity

As indicated earlier, chronic gasoline exposures produces renal tumors in rats.

REGULATIONS AND STANDARDS

The American Conference of Governmental Industrial Hygienists (ACGIH 1990) adopted a threshold limit value (TLV) of 300 ppm (mg/m^3) for gasoline vapors. Because of the complexity and variability in composition, OSHA has no standard but regulates the toxic components by their respective PELs (i.e., n-hexane, benzene, alkyl lead).

Gasoline as such is not mentioned in HEAST (1990) as having a specific cancer slope factor (CSF) or reference dose (RfD). However, individual components such as benzene, aromatics, n-hexane having CSF or RfD values should be evaluated by themselves.

COMPOUND CAS NO.	ACGIH TLV ppm	RfD (inhal) mg/kg/day	RfD (oral) mg/kg/day	SLOPE FACTOR mg/kg/day	SLOPE FACTOR mg/kg/day
Benzene 71-43-2	0.1	N/A	N/A	2.9E-2	2.9E-2
Ethylene Dibromide 106-93-4	A2[1]	N/A	N/A	7.6E-1	8.5E+1
Ethylene Dichloride 107-06-2	10	N/A	N/A	9.1E-2	9.1E-2
n-Hexane 110-54-3	50	6E-1	2E-1	N/A	N/A
Tetraethyl Lead 78-00-2	0.1[2]	1E-7	2.9E-8	N/A	N/A

1 A2 - Substance classed as a suspected human carcinogen, no ACGIH TLV listed.
2 mg/m^3, not ppm.

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TOXICOLOGY PROFILE FOR DIESEL FUEL

GENERAL DATA

Petroleum fuels are classified into light, middle and heavy distillate fuels. Gasoline is a typical light distillate fuel while diesel fuel is considered to be a middle distillate material obtained from the distillation of crude oil. Included in this category of middle distillate fuels are jet fuel, kerosene and #2 fuel oils. As a result, many of the ecological and toxicological effects of these materials are very similar.

The chemical composition of diesel fuel is extremely variable and depends upon the crude oil source, types of processing and refining, blending and additives employed. These fuels are formulated to meet physical characteristics and not a specific chemical composition. Viscosity and volatility are the principal determinants of the fuel specifications. Diesel #1 is primarily a kerosene type of fuel and produced mainly from straight run middle distillates. Diesel #2 also contains straight run middle distillate but is also blended with straight run kerosene, straight run gas oils, light vacuum distillate and light thermally and/or catalytically cracked streams (IARC 1989).

As with other petroleum derived fuels, the chemical composition of diesel fuels consists of paraffins, olefins, cycloparaffins, isoparaffins, and aromatics as well as additives. Additives can include amyl nitrates and alcohols, n-hexyl nitrate and octyl nitrate at levels of 0.1 to 0.2 percent that are used as cetane number enhancers (Kirk-Othmer 1984). The total aromatic content of diesel fuel is also variable but levels between 23 to 38 percent have been reported. The average total aromatic is probably in the range of 25 percent. The concentration of the principal aromatic species of toxicological significance is presented in Table 2.

TABLE 2. REPRESENTATIVE VALUES FOR TOXICOLOGICALLY SIGNIFICANT AROMATIC CONTENT FOR DIESEL FUEL # 2.

COMPONENT	APPROXIMATE CONCENTRATION
Benzene	<50 ppm with an average of 10 ppm
Ethylbenzene	300 ppm
Toluene	200 ppm (max)
Xylene (mixed)	2,400 ppm

(personal communication, Chevron Corp.)

The odor threshold of diesel fuel is approximately 0.8 ppm.

FATE AND TRANSPORT

Microbial degradation, plus evaporation, can remove up to 90 percent of the added diesel fuel to **soil**. Depending on the soil characteristics, the half-life of diesel fuel in soil ranges for one to

eight weeks (Song 1988). Volatilization to the **air** occurs and diesel fuel can be detected by its odor in the air. However, a vapor pressure value could not be located in the literature. Diesel fuel will percolate through the soil and float on the ground **water**. When spilled onto surface water, diesel fuels can be toxic to fish, waterfowl and algae.

TOXICITY DATA

Human Toxicological Profile

Like other solvents, diesel fuel can be expected to have central nervous system (CNS) depressant activity. However, since this fuel is not as volatile as gasoline, breathing vapors at concentrations sufficient to achieve a level of intoxication is not likely at normal temperatures and pressures. An attempt to generate a kerosene (diesel) laden atmosphere only resulted in an ambient concentration of 14 ppm (Carpenter et al. 1976). However, under certain occupational settings like tank cleaning, it may be possible to generate mists or aerosols that can lead to symptoms of overexposure. As with kerosene, these symptoms may include headache, dizziness, weakness, confusion, drowsiness, and possibly death (HSDB 1991).

Ingestion of diesel fuel can occur during siphoning, accidentally or intentionally and from contaminated well-water. Ingestion may be accompanied by a burning sensation in the mouth, pharynx, and chest, gastrointestinal hypermotility, and diarrhea (Gosselin et al. 1984), and possibly nausea and vomiting. A serious complication is the aspiration of hydrocarbons into the lung which produces a potentially-lethal hemorrhagic pneumonitis (Lee and Seymour 1979).

There have been reports of acute renal failure following persons exposed to diesel fuel (Barrientos et al. 1977; Crisp et al. 1979). Kryzanovskij (1971) reports that workers cleaning diesel storage tanks have an increased incidence of disease in general and cardiovascular disease and bronchitis, in specific, over control shipyard workers.

Animal Toxicology and Significant Studies

The acute oral and dermal LD_{50} of diesel fuel is in the range of 9 ml/kg body weight. Eye irritation properties were minimal, but the primary skin irritation score of a marketplace sample was 6.8 indicating that this material is a strong skin irritant (Beck et al. 1982). Chronic skin contact can be expected to produce defatting, fissuring, and cracking. There are no readily available reports on hypersensitivity response to diesel fuels can be expected to occur since products on either side of diesel fuels distillation range have been reported to produce hypersensitivity reactions (Beck et al. 1982). Dermal absorption of gasoline is unlikely to result in systemic toxicity, but chronic poisoning of the readily absorbable alkyl lead additives is possible.

Exposure of CD-1 mice to diesel vapor for eight hours per day on five consecutive days resulted in a decrement of performance on the roto-rod test, square box activity test, and hot plate test. However, the corneal reflex and inclined plane test was unaffected. General observations noted vasodilation, ataxia, poor grooming, and in some cases tremor (Kainz and White 1982).

Exposure of rats to aerosolized diesel fuel at concentrations up to 6 mg/L produced direct toxic effects on the lungs but did not produce any neurotoxicity (Dalbey et al. 1987).

Reproductive Toxicity

Female rats were exposed 6 hours per day to air concentrations of 0, 100, and 400 ppm during days 6 through 15 of gestation. Neither jet fuel or number 2 fuel oil produced any significant detrimental effects on the reproductive parameters of the experimental animals (Beliles and Mecler 1982). Neither Jet Fuel A or diesel fuel at exposure levels of 400 ppm, 6 hrs per day, 5 day per week for 8 weeks reduced the fertility of CD-1 male mice (API 1980a, 1980b).

Genotoxicity

Kerosene, jet fuel and diesel fuel all tested negatively in the standard Ames bioassay. However, the "Modified Ames Assay" (Blackburn et al. 1988) on two straight run gas oils did demonstrate mutagenicity. (Straight run gas oil can be considered similar to diesel oils). Diesel fuel was also negative in the mouse lymphoma assay but positive on the rat bone marrow cytogenetics assay when administered by intraperitoneal injection (Conaway et al. 1982). Heating oil #2 did produce a positive Ames test as well as positive results in two other short term bioassays (Rothman and Emmett 1988). Dominant lethal testing of Jet fuel A and diesel fuel was negative at 400 ppm to male CD-1 mice (API 1980a, 1980b).

Carcinogenicity

In a classical mouse skin painting bioassay, all petroleum fractions derived from a crude oil source that boiled between 120 and 700°F showed a low level of tumorigenic activity (Lewis et al. 1982). Home heating oil also showed a low level of tumorigenicity in a more recent mouse skin painting assay (Witschi et al. 1987).

In a case referent study, Seimiatycki et al. (1987) reported an increase of several specific cancers associated with exposures to different petroleum products. Leaded gasoline was associated with stomach cancer; aviation gasoline with kidney cancer; diesel fuel with non adenocarcinoma of the lung and prostate cancer and mineral spirits with squamous cell lung cancer. However, not all parameters of concern were properly controlled, excluded or assessed making conclusions from this study inappropriate.

IARC (1989) has classified diesel fuel as having limited evidence of carcinogenicity in animals. Light diesel fuels are not classifiable as to their carcinogenicity to humans (Group 3).

REGULATIONS AND STANDARDS

Neither the American Conference of Governmental Industrial Hygienists (ACGIH) nor OSHA have recommended or established permissible exposure standards (PELs) for diesel fuels. However, NIOSH has recommended a 10 hour TWA of 100 mg/m^3 for kerosene or 14 ppm (NIOSH 1977). Because of the complexity and variability in composition, OSHA regulates the toxic components by their respective PELs (i.e., n-hexane, benzene, etc.).

Diesel fuels, as such, are not mentioned in HEAST, 1990, nor identified for a specific cancer Potency Factor (CPF) or reference dose (RfD). However, individual components such as benzene, other aromatics and for n-hexane having CPF or RfD values should be evaluated by themselves.

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BENZENE

Benzene is readily absorbed following oral and inhalation exposure (EPA 1985). The toxic effects of benzene in humans and other animals following exposure by inhalation include central nervous system effects, hematological effects, and immune system depression. In humans, acute exposures to high concentrations of benzene vapors have been associated with dizziness, nausea, vomiting, headache, drowsiness, narcosis, coma, and death (NAS 1976). Chronic exposure (at least 20 years of worker exposure) to benzene vapors [1-100 ppm 8-hour time-weighted-average (TWA)] can produce reduced leukocyte, platelet, and red blood cell counts (EPA 1993). Benzene induced tumors of the zymbal gland, oral cavity, leukemia, and lymphoma in rodents chronically exposed by gavage to doses in the range of 25-500 mg/kg/day (Huff et al. 1989; NTP 1986; Maltoni et al. 1989). Many studies have also described a causal relationship between exposure to benzene by inhalation (either alone or in combination with other chemicals) and leukemia in humans (IARC 1982; Rinsky et al. 1981; Ott et al. 1978; Wong et al. 1983).

Applying EPA's criteria for evaluating the overall evidence of carcinogenicity to humans, benzene is classified in Group A (Human Carcinogen) based on adequate evidence of carcinogenicity from epidemiological studies. EPA (1993) derived an oral cancer slope factor of 2.9×10^{-2} $(mg/kg/day)^{-1}$ and an inhalation unit risk of 8.3×10^{-6} $(ug/m^3)^{-1}$ for benzene. These values were based on several studies in which increased incidence of nonlymphocytic leukemia were observed in humans occupationally exposed to benzene principally by inhalation (Rinsky et al. 1981; Ott et al. 1978; Wong et al. 1983). Equal weight was given to cumulative dose and weighted cumulative dose as well as to relative and absolute risk model forms (EPA 1993). EPA (1993) is currently reviewing both oral and inhalation RfDs for benzene, for which the status is pending.

The National Research Council's Committee on Toxicology has set a one-hour Emergency Exposure Guidance Level (EEGL), for benzene at 50 ppm (200 mg/m^3) (NRC 1986). Formerly known as just EEL, the EEGL is defined as a ceiling limit for an unpredicted single exposure lasting one to 24 hours whose occurrence is expected to be rare in the lifetime of any person. It is designed to avoid substantial decrements in performance during emergencies and takes into account the statistical likelihood of a non-incapacitative, reversible effect in exposed populations (NRC 1986). A health criterion for acute inhalation exposure to benzene of 20 mg/m^3 can be derived from the EEGL by combining it with a safety factor of 10 to account for the healthy worker effect which assumes employed persons are generally healthier than the general population.

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TOXICOLOGY PROFILE FOR WASTE OIL

GENERAL DATA

The term Waste Oil is a broad classification and generic term used in common practice by refiners, hazardous waste specialists, law enforcement agencies, fire departments, and lay public. As can be seen in the "synonym" section above, it can encompass a very broad selection of chemicals, ranging from grease to fuels. The rationale for selecting the above terms as representative of Waste Oil is that these terms will most likely provide the sources of the material that will be presented to a waste site operator.

Lubricating oil is produced in vast quantities, as much as 1 to 2 percent of the world's refined crude oil, (24 million tons, Vazquez-Duhalt 1989). The chemical composition of any heterogeneous material is often difficult to assess. For the purposes of this "brief", it is assumed that "waste oil" was originally generated from petroleum. As with fuels, the composition of waste oil will be extremely variable and depend upon the original crude oil source, type of processing and refining, blending, additives, and use history. The waste oil may, therefore, range from virgin oil accidentally spilled to used machine or automotive oil.

Petroleum oils are produced from the middle to heavy distillate fractions of crude oil. Due to the high boiling points for these fractions, the aromatic hydrocarbons benzene, ethylbenzene, toluene and xylenes, typically found in fuels, will not be present in oils at significant quantities. These fractions may be further processed or treated to remove unwanted materials such as nitrogen, sulfur, metals, or polynuclear aromatic hydrocarbons (PAHs). For the most part, oils destined for the consumer market have been laundered to a very low content of PAHs. However, oils in refinery spills may contain several hundred ppm of PAHs. Used motor oil contains Pb, Zn, Cu, Cd, Cr, Ni, and other metals. Lead is the most abundant metal in motor oil up to a maximum of one percent lead (Vazquez-Duhalt 1989).

FATE AND TRANSPORT

Oil with characteristics (e.g. vapor pressure, viscosity) closer to fuel oils may volatilize to some extent to the air. However, microbial degradation will, more than likely, be the primary mechanism for the mineralization of the spilt material. As much as 90 percent of the material resembling jet fuel may be removed by a combination of evaporation and microbial degradation with a half-life of 1 to 8 weeks; in contrast, heavier fractions which resemble bunker oil (C_{15} and above) may only be degraded 25 to 30 percent and be extremely persistent in soils (Song 1988). Given the correct circumstances, waste oils can percolate through the soil and float on the ground water. When spilled onto surface water, waste oils can be toxic to fish, waterfowl, and algae. However, these possibilities are highly dependent upon the characteristics of the oily material and the size of the spill.

Approximately 30 percent of waste motor oil and lubricants produced are released into the environment. Because of the large quantities involved, the persistence of oil residues in the environment, and the potential for ecotoxicity, waste oils are an important environmental concern (Vazquez-Duhalt 1989).

When petroleum oil is spilt onto soil, it fill the spaces between the soil particles and hampers oxygen access, thereby promoting anaerobic zones. On the periphery of these oil-soiled zones, aerobic, bacteria are promoted. Hence these outer zones show increased nitrifying, denitrifying,

ammonifying, and hydrocarbon oxidizing microorganisms. The activity of these organisms in the outer zones increases the concentration of easily accessible substrates which stimulates an increase in the numbers of anaerobic nitrogen fixing bacteria (Vasques-Duhalt 1989). Thus under certain circumstances, oil addition to soil can function as an amendment thereby increasing the productivity of the soil.

TOXICITY DATA

Human Toxicology

In general, most oily materials derived from petroleum have a low order of toxicity. Inhalation of components of waste oil at concentrations sufficient to achieve a level of intoxication is not likely at normal temperatures and pressures. An attempt to generate a kerosene (diesel) laden atmosphere only resulted in an ambient concentration of 14 ppm (Carpenter et al. 1976). However, under certain occupational settings like tank cleaning, it may be possible to generate mists or aerosols that can lead to symptoms of overexposure. These symptoms may include headache, dizziness, nausea, gastrointestinal symptoms, shortness of breath, weakness, confusion, drowsiness, and possibly death (HSDB 1991). A single report on a chronic repeated exposure to an oil mist for 17 years was considered to be the cause of lipid pneumonia in a workers "heavily" exposed (Proctor et al. 1989).

Ingestion of petroleum waste oil (other than fuel oil) either accidentally, intentionally or from contaminated well-water is not expected to have a significant effect except perhaps induction of some gastrointestinal hypermotility and diarrhea (MacFarland et al. 1982), and possibly nausea and vomiting. Other than ingestion of fuel oils, ingestion of the heavier waste oils is not expected to be complicated by aspiration into the lung which produces a potentially-lethal hemorrhagic pneumonitis (Lee and Seymour 1979).

Mammalian Toxicology and Significant Studies

The acute oral and dermal LD_{50} of petroleum waste oil is expected to demonstrate only a low order of toxicity; certainly greater than 5 g/kg or practically non toxic. Diesel fuel has an acute oral LD50 is in the range of 9 ml/kg body weight. New or used motor oil has an LD50 of 25 ml/kg as does heavy fuel #6. Other properties such as eye irritation have ratings of practically non irritating to mildly irritating. Skin irritation scores are similarly low ranging from non irritating to mildly irritating (Beck et al. 1982). There are no readily available reports on hypersensitivity responses to waste oils but sensitization can be an expected outcome since refined products in this distillation range have been reported to produce hypersensitivity reactions (Beck et al. 1982). Dermal absorption of oil can also be expected but the oil itself is unlikely to be the cause of a systemic toxicity. Any toxicity is more likely to be attributable to a concomitant absorption of some non oil contaminant.

Exposure of CD-1 mice to diesel vapor for eight hours per day on five consecutive days resulted in a decrement of performance on the roto-rod test, square box activity test, and hot plate test. However, the corneal reflex and inclined plane test was unaffected. General observations noted vasodilation, ataxia, poor grooming, and in some cases tremor (Kainz and White 1982).

Exposure of rats to aerosolized diesel fuel at concentrations up to 6 mg/L produced direct toxic effects on the lungs but did not produce any neurotoxicity (Dalbey et al. 1987).

Reproductive Toxicity

Female rats were exposed 6 hours per day to air concentrations of 0, 100, and 400 ppm during days 6 through 15 of gestation. Neither jet fuel or number 2 fuel oil produced any significant detrimental effects on the reproductive parameters of the experimental animals (Beliles and Mecler 1982). Neither Jet Fuel A or diesel fuel at exposure levels of 400 ppm, 6 hrs per day, 5 day per week for 8 weeks reduced the fertility of CD-1 male mice (API 1980a, 1980b).

External application of new or used motor oil to the egg shell of a number of bird species indicated embryotoxicity and lethality. The used motor oil was more toxic than the new motor oil (Hoffman et al. 1982).

Genotoxicity

Ames testing of several common fuel oils produced mainly negative results. However, the "Modified Ames Assay" introduced by Blackburn et al. (1988) did demonstrate mutagenicity in two straight run gas oils that were previously considered to be negative. Diesel fuel was negative in a mouse lymphoma assay but positive on the rat bone marrow cytogenetics assay when administered by intraperitoneal injection (Conaway et al. 1982). Heating oil #2 did produce a positive Ames test as well as positive results in two other short term bioassays (Rothman and Emmett 1988).

Used motor oil has been shown to be highly mutagenic to Salmonella bacteria (Peake and Parker 1980). New crankcase motor oil initially tested negative with the standard Ames Assay but after an extraction procedure to remove "interfering chemicals", a dose dependent mutagenic response was observed with both gasoline and diesel crankcase oils. The extracts of the new motor oils however, are considerably less mutagenic than the Used Cankcase Oil extracts. This effect can be explained by the fact that during engine operation, the oil accumulates combustion dust and PAH formed in the combustion process or directly from the fuel (Thony et al. 1975). Extracts from the diesel and gasoline type engines were about equally potent (Dutcher et al. 1986).

Carcinogenicity

In classical mouse skin painting bioassays, all petroleum fractions derived from a crude oil source that boiled between 120 and 700°F showed a low level of tumorigenic activity (Lewis et al. 1982). Home heating oil also showed a low degree of tumorigenicity in a more recent mouse skin painting assay (Witschi et al. 1987). Topical application of used motor oil from gasoline driven vehicles increased the incidence of local tumors in a dose related fashion. The application of new motor oil to mouse skin did not induce skin tumors (Saffiotti and Shubik 1963). This information plus the demonstrated mutagenic potential of used motor oils and their polynuclear aromatic hydrocarbon (PAH) content, allows a determination that such oils can be considered to be potentially carcinogenic (IARC 1984).

In a case referent study, Seimiatycki et al. (1987) reported an increase of several specific cancers associated with exposures to different petroleum products. Leaded gasoline was associated with stomach cancer; aviation gasoline with kidney cancer; diesel fuel with non adenocarcinoma of the lung and prostate cancer and mineral spirits with squamous cell lung cancer. However not all parameters of concern were properly controlled, excluded or assessed making conclusions from this study inappropriate.

IARC (1989) has classified gasoline, diesel fuel, and residual oil Category 2B, having limited evidence of carcinogenicity in animals and inadequate evidence in humans. Used motor oil (crankcase oil) is also classified as a category 2B. Light fuel oils, crude oil, and jet fuels have been classified as Category 3, having inadequate evidence of carcinogenicity in either animals or humans.

REGULATIONS AND STANDARDS

Neither the American Conference of Governmental Industrial Hygienists (ACGIH) nor OSHA have recommended or established permissible exposure standards (PELs) for diesel fuels or waste oils. NIOSH has recommended a 10 hour TWA of 100 mg/m^3 for kerosene or 14 ppm (MMWR 37:24). The ACGIH (1991) and OSHA (1985) recommend a TLV of 5 mg/m^3 for Oil Mists.

Diesel fuels, as such, are not mentioned in HEAST, 1990, nor identified for a specific cancer Slope Factor (CSF) or reference dose (RfD). However, individual components such as benzene, other aromatics and for n-hexane having CSF or RfD values should be evaluated by themselves.

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TRICHLOROETHENE

Absorption of trichloroethene (TCE) from the gastrointestinal tract is virtually complete. Absorption following inhalation exposure is proportional to concentration and duration of exposure (EPA 1985). TCE is a central nervous system depressant following acute and chronic exposures. In humans, single oral doses of 15 to 25 ml (21 to 35 grams) of TCE have resulted in vomiting and abdominal pain, followed by transient unconsciousness (Stephens 1945). High-level exposure can result in death due to respiratory and cardiac failure (EPA 1985). Hepatotoxicity has been reported in human and animal studies following acute exposure to TCE (EPA 1985). Nephrotoxicity has been observed in animals following acute exposure to TCE vapors (ACGIH 1986; Torkelson and Rowe 1981). Subacute inhalation exposures of mice have resulted in transient increased liver weights (Kjellstrand et al. 1983a,b). Industrial use of TCE is often associated with adverse dermatological effects including reddening and skin burns on contact with the liquid form, and dermatitis resulting from vapors. These effects are usually the result of contact with concentrated solvent, however, and no effects have been reported following exposure to TCE in dilute, aqueous solutions (EPA 1985). TCE has caused significant increases in the incidence of hepatocellular carcinomas in mice (NCI 1976) and renal tubular-cell neoplasms in rats exposed by gavage (NTP 1983), and pulmonary adenocarcinomas in mice following inhalation exposure (Fukuda et al. 1983; Maltoni et al. 1986). TCE was mutagenic in *Salmonella typhimurium* and in *E. coli* (strain K-12), utilizing liver microsomes for activation (Greim et al. 1977).

EPA is currently reviewing the carcinogenicity of TCE. The EPA Environmental Criterial and Assessment Office (ECAO) currently classifies TCE as a Group B2/C--Probable/Possible Human Carcinogen based on inadequate evidence in humans and sufficient evidence of carcinogenicity from animal studies. ECAO (1992) reported an oral cancer potency factor of 1.1×10^{-2} $(mg/kg/day)^{-1}$ based on two gavage studies conducted in mice in which an increased incidence of liver tumors were observed (Maltoni et al. 1986; Fukuda et al. 1983). An inhalation cancer unit risk of 1.7×10^{-6} $(\mu g/m^3)^{-1}$ has been derived for TCE based on an increased incidence of lung tumors in mice exposed via inhalation (ECAO 1992; NCI 1976). The cancer estimates are currently under review by EPA. EPA (1987) developed an oral reference dose (RfD) of 7.35×10^{-3} mg/kg/day based on a subchronic inhalation study in rats in which elevated liver weights were observed following exposure to 55 ppm, 5 days/week for 14 weeks (Kimmerle and Eben 1973). A safety factor of 1,000 was used to calculate the RfD. However, this RfD is currently under review by EPA.

The National Research Council's Committee on Toxicology has set a one-hour Emergency Exposure Guidance Level (EEGL), for trichloroethene at 200 ppm (1,000 mg/m^3) (NRC 1988). Formerly known as just EEL, the EEGL is defined as a ceiling limit for an unpredicted single exposure lasting one to 24 hours whose occurrence is expected to be rare in the lifetime of any person. It is designed to avoid substantial decrements in performance during emergencies and takes into account the statistical likelihood of a non-incapacitative, reversible effect in exposed populations (NRC 1988). A health criterion for acute inhalation exposure to trichloroethene of 100 mg/m^3 can be derived from the EEGL by combining it with a safety factor of 10 to account for the healthy worker effect which assumes employed persons are generally healthier than the general population.

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TETRACHLOROETHENE

Tetrachloroethene is absorbed following inhalation (IARC 1979) and oral (EPA 1985a,b) exposure. Tetrachloroethene vapors and liquid also can be absorbed through the skin (EPA 1985a,b). The principal toxic effects of tetrachloroethene in humans and animals following acute and longer-term exposures include central nervous system (CNS) depression and fatty infiltration of the liver and kidney with concomitant changes in serum enzyme activity levels indicative of tissue damage (EPA 1985a,b; Buben and O'Flaherty 1985). Humans exposed to doses of between 136 and 1,018 mg/m^3 for 5 weeks develop central nervous system effects, such as lassitude and signs of inebriation (Stewart et al. 1974). The offspring of female rats and mice exposed to high concentrations of tetrachloroethene for 7 hours daily on days 6-15 of gestation developed toxic effects, including a decrease in fetal body weight in mice and a small but significant increase in fetal resorption in rats (Schwetz et al. 1975). Mice also exhibited developmental effects, including subcutaneous edema and delayed ossification of skull bones and sternebrae (Schwetz et al. 1975). In a National Cancer Institute bioassay (NCI 1977), increased incidence of hepatocellular carcinoma were observed in both sexes of B6C3F1 mice administered tetrachloroethylene in corn oil by gavage for 78 weeks. Increased incidence of mononuclear cell leukemia and renal adenomas and carcinomas (combined) have also been observed in long term bioassays in which rats were exposed to tetrachloroethene by inhalation (NTP 1986).

Tetrachloroethene is currently under review by the Carcinogen Risk Assessment Verification Endeavor (CRAVE) and estimates of cancer potency were recently withdrawn by EPA (1992b). However, the EPA Environmental Criteria and Assessment Office (ECAO) (1992a) currently classifies tetrachloroethene as a Group B2/C carcinogen (Probable/Possible Human Carcinogen). ECAO (1992a) has reported an oral slope factor of 5.2 x 10^{-2} (mg/kg/day)$^{-1}$ based on liver tumors observed in the NCI (1977) gavage bioassay for mice. An inhalation cancer unit risk of 5.8 x 10^{-7} (μg/m^3)$^{-1}$ is based on an NTP (1986) bioassay in rats and mice in which leukemia and liver tumors were observed (ECAO 1992a). Both the cancer slope factor and unit risk are currently under review by EPA. EPA (1993) also derived an oral reference dose (RfD) of 1 x 10^{-2} mg/kg/day for tetrachloroethene based on a 6-week gavage study by Buben and O'Flaherty (1985). In this study, liver weight/body weight ratios were significantly increased in mice and rats treated with 71 mg/kg-day tetrachloroethene but not in animals treated with 14 mg/kg-day. Using a NOAEL of 14 mg/kg/day and applying an uncertainty factor of 1,000 the RfD was derived. EPA (1992b) established a subchronic oral RfD of 1 x 10^{-1} mg/kg/day, using an uncertainty factor of 100 and based on the same study and effect of concern.

The American Conference of Governmental Industrial Hygienists (ACGIH) has set a Short-Term Exposure Level -- Threshold Limit Value of 200 ppm (1,000 mg/m^3) for tetrachloroethene (ACGIH 1991). The STEL-TLV is defined as a 15-minute time-weighted average which should not be exceeded at any time during a work day. A health criterion for acute inhalation exposure to tetrachloroethene of 100 mg/m^3 can be derived from the STEL-TLV by combining it with a safety factor of 10 to account for the healthy worker effect which assumes that employed persons are generally healthier than the general population.

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BARIUM

Barium and compounds are absorbed to a limited extent following oral and inhalation exposures (ATSDR 1992). Following acute ingestion, respiratory weakness, paralysis, hypertension, and abnormalities in heart rhythm have been frequently observed (ATSDR 1992). In occupationally exposed workers, inhalation of barium sulfate has been associated with a minor lung effect called baritosis, a benign pneumoconiosis (Doig 1976; Goyer 1986). Several epidemiological studies investigated the effect of elevated barium levels in drinking water and its associated effect on blood pressure, hypertension, stroke, heart disease, and altered electrocardiograms. No adverse effects were found as high as 10 mg/L (0.21 mg/kg/day) (Brenniman and Levy 1984, 1985; Brenniman et al. 1979a,b, 1981; Wones et al. 1990). In animals, however, subchronic and chronic oral exposure of rats to barium (as high as 7.1 mg/kg/day for one month and as low as 0.54 mg/kg/day for 16 months) resulted in increased blood pressure and cardiovascular cellular changes (Kopp et al. 1985; Perry et al. 1983, 1985, 1989). One animal study did not result in adverse effects at the highest dose tested of 15 mg/kg/day (McCauley et al. 1985); two other studies did not result in adverse effects but did not measure blood pressure (Schroeder and Mitchener 1975a,b; Tardiff et al. 1980). Subchronic inhalation of barium carbonate dust (3.6 mg/m^3) by experimental animals has been associated with reduced sperm count, increased fetal mortality, atresia of the ovarian follicles, decreased body weight, and alterations in liver function (Tarasenko et al. 1977).

EPA (1993a) derived an oral reference dose (RfD) based on a weight of evidence approach which takes into account recent findings of two human epidemiologic studies (Brenniman and Levy 1984; Wones et al. 1990) as well as various rodent studies which have been conducted (Perry et al. 1983; McCauley et al. 1985; Schroeder and Mitchener 1975a,b; Tardiff et al. 1980). No single study considered alone was appropriate to calculate a lifetime RfD for barium (EPA 1993a). A LOAEL was not identified in either of the two epidemiological studies; however, the effect of concern in the animal studies was high blood pressure. Using a NOAEL of 0.21 mg/kg/day (Wones et al. 1990) and an uncertainty factor of 3, an oral RfD of 7×10^{-2} mg/kg/day was calculated. The chronic RfD was adopted as a subchronic RfD by EPA (1993b). EPA (1993b) has also developed chronic and subchronic inhalation RfCs of 5×10^{-4} and 5×10^{-3} mg/m^3 for barium based on a study by Tarasenko et al. (1977). In this study, rats were exposed to barium carbonate dust at airborne concentrations of up to 5.2 mg/m^3 for 4-6 months. Adverse effects noted at this concentration included decreased body weight, alterations in liver function, and increased fetal mortality. Uncertainty factors of 1,000 and 100 were used in developing the chronic and subchronic RfCs, respectively.

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cis-1,2-DICHLOROETHENE

EPA (1984) reported that *cis*-1,2-dichloroethene would be expected to be absorbed following oral, inhalation, or dermal exposure based on its chemical properties of low molecular weight, lipid solubility, and neutral charge. It is in the same chemical class as 1,1-dichloroethene and is expected to be eliminated rapidly via the urine within two to three days after exposure has ended (EPA 1987). *cis*-1,2-Dichloroethene was once used as an anesthetic gas and thus at high doses general anesthetic and narcotic effects are produced (Irish 1963). Acute exposure to 400 mg/kg of the chemical have caused a significant elevation of liver alkaline phosphatase in rats (Jenkins et al. 1972). Subchronic gavage administration to rats resulted in decreased hematocrit and hemoglobin (McCauley et al. n.d). *cis*-1,2-Dichloroethene was not mutagenic in a bacterial assay with or without activation (Greim et al. 1975), did not induce point mutations, mitotic gene conversions, or mitotic recombinations in yeast (Galli et al. 1982a), or induce mutations in a host-mediated assay (Galli et al. 1982b).

EPA (1993) calculated an oral RfD for *cis*-1,2-dichloroethene of 1×10^{-2} mg/kg/day based on a study in rats administered *cis*-1,2-dichloroethene by gavage for 90 days (McCauley et al. n.d). Decreased hematocrit and hemoglobin were observed at 32 mg/kg/day. An uncertainty factor of 3,000 was used to calculate the RfD.

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MANGANESE

Manganese is considered to be among the least toxic of the trace metals and, in fact, is considered to be an essential element (NRC 1989). The oral absorption of dietary manganese ranges from 3 to 10 percent (EPA 1993). However, manganese is absorbed to a greater extent following inhalation exposures. The National Research Council has established a provisional recommended dietary allowance for adults of 2 to 5 mg/day (NRC 1989). The effects following acute exposure to manganese are unknown.

Chronic occupational exposure to manganese dust (0.02 - 2.6 mg/m^3) has been associated with respiratory symptoms and pneumonitis (Chandra et al. 1981, 1990) and higher levels have been associated with a condition known as manganism, a progressive neurological disease characterized by speech disturbances, tremors, and difficulties in walking. For example, male workers exposed to manganese dioxide, tetroxide and various salts [time-weighted-average (TWA) of total airborne manganese dust ranged from 0.07-8.61 mg/m^3] experienced an increased incidence of psychomotor disturbances (e.g., reaction time, hand-eye coordination, and hand steadiness) (Roels et al. 1987). Other effects observed in humans occupationally exposed to manganese dust include hematological (Chandra et al. 1981; Flinn et al. 1941; Kesic and Hausler 1954), cardiovascular (Saric and Hrustic 1975) and reproductive effects (Cook et al. 1974; Emara et al 1971; Lauwerys et al 1985; Rodier 1955).

In adults, a safe intake of manganese from dietary sources ranges from 2-10 mg/day (10 mg/day = 0.14 mg/kg/day) (WHO 1973; NRC 1989; Schroeder et al. 1966). Individuals who chronically ingested drinking water from natural wells containing manganese concentrations of 1,600 to 2,300 ug/L (0.06 mg/kg/day), showed a statistically significant increase in minor neurologic effects (neurologic exam scores) (Kondakis et al. 1989). Higher concentrations in drinking water (0.8 mg/kg/day) have resulted in symptoms including lethargy, increased muscle tonus, tremor and mental disturbances (Kawamura et al. 1941).

The apparent differences in manganese toxicity following dietary and drinking water exposures can be attributed to the greater bioavailability of manganese from water (EPA 1993). Chronic oral exposure of rats to manganese chloride can also result in central nervous system dysfunction (Leung et al. 1981; Lai et al. 1982). Chronic inhalation exposure of experimental animals (monkeys, rats, mice, hamsters) has resulted in respiratory effects; however, other studies have demonstrated that these effects may be immunological in origin (ATSDR 1992).

Manganese has not been reported to be teratogenic; however, this metal has been observed to cause depressed reproductive performance and reduced fertility in humans and experimental animals (EPA 1984a). Certain manganese compounds have been shown to be mutagenic in a variety of bacterial tests. Manganese chloride and potassium permanganate can cause chromosomal aberrations in mouse mammary carcinomal cells. Manganese was moderately effective in enhancing viral transformation of Syrian hamster embryo cells (EPA 1984a,b).

EPA (1993a) established a weight-of-evidence classification for manganese of D (not classifiable as to human carcinogenicity). EPA (1993a) derived two separate oral reference doses (RfD). The separate RfDs for food and water indicate a potentially higher bioavailability of manganese from drinking water than from the diet. The RfD associated with oral exposure to drinking water is 5×10^{-3} mg/kg/day based on a no-observed-adverse-effect-level (NOAEL) of 5×10^{-3} mg/kg/day for humans (Kondakis et al. 1989). EPA (1993a) also derived an RfD of 1.4×10^{-1} mg/kg/day for manganese in food based on a NOAEL of 0.14 mg/kg/day (10 mg/day) in humans chronically

exposed to dietary levels (WHO 1973; Schroeder et al. 1966; NRC 1989). The effect of concern was the central nervous system, and an uncertainty factor of one was used to derive both RfDs. The chronic RfD in food was adopted as the subchronic RfD (EPA 1993b). EPA (1993a) derived a chronic inhalation reference concentration (RfC) of 4 x 10^{-4} mg/m^3 based upon an occupational study conducted by Roels et al. (1987) in which respiratory symptoms and psychomotor disturbances were observed. EPA (1993b) adopted the chronic RfC as the subchronic RfC. An uncertainty factor of 900 was used to derive both RfCs.

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TOLUENE

Toluene is absorbed in humans following both inhalation and dermal exposure (EPA 1985). In humans, the primary acute effects of toluene vapor are central nervous system (CNS) depression and narcosis. These effects occur at concentrations of 200 ppm (754 mg/m^3) (Von Oettingen et al. 1942a,b). In experimental animals, acute oral and inhalation exposures to toluene can result in central nervous system (CNS) depression and lesions of the lungs, liver, and kidneys (EPA 1987). The earliest observable sign of acute oral toxicity in animals is depression of the CNS, which becomes evident at approximately 2,000 mg/kg (Kimura et al. 1971). In humans, chronic exposure to toluene vapors at concentrations of approximately 200 and 800 ppm has been associated with CNS and peripheral nervous system effects, hepatomegaly, and hepatic and renal function changes (EPA 1987; Anderson et al. 1983). Female workers exposed to toluene vapor at 332 mg/m^3 (88 ppm) as a time-weighted average developed CNS effects (statistically significant differences in neurobehavorial tests); however, co-exposure to other solvents was not addressed (Foo et al. 1990). Toxic effects following prolonged exposure of experimental animals to toluene are similar to those seen following acute exposure (Hanninen et al. 1976; Von Oettingen et al. 1942a). In rats, chronic exposure to toluene via inhalation results in CNS toxicity, a dose-related reduction in hematocrit values and degeneration of the nasal and respiratory epithelium (CIIT 1980; NTP 1990). The liver and kidney are the target organs in rats following prolonged gavage administration (NTP 1989). There is some evidence in mice that oral exposure to greater than 0.3 ml/kg toluene during gestation results in embryotoxicity (Nawrot and Staples 1979). Inhalation exposure of up to 1,000 mg/m^3 by pregnant rats during gestation has been associated with significant increases in skeletal retardation (Hudak and Ungvary 1978). None of the available data suggest that toluene is carcinogenic (ATSDR 1992).

EPA derived a chronic (EPA 1993a) and subchronic (EPA 1993b) oral reference dose (RfD) of 2 x 10^{-1} and 2 mg/kg/day, respectively for toluene based on a gavage study in which rats were given doses as high as 5,000 mg/kg 5 days/week for 13 weeks and changes in liver and kidney weights were observed (NTP 1989). No adverse effects were observed in any of the treated animals at 223 mg/kg/day (NOAEL). Uncertainty factors of 1,000 and 100, respectively were used to calculate the oral RfDs. EPA (1993a) reported a chronic inhalation RfC for toluene of 4 x 10^{-1} mg/m^3 based on the development of adverse CNS effects in humans at 332 mg/m^3 (88 ppm) (Foo et al. 1990) and degeneration of the nasal epithelium in rats at 2,261 mg/m^3 (600 ppm) (NTP 1990). An uncertainty factor of 300 was used to calculate the RfC. EPA (1993b) derived a subchronic RfC of 2 mg/m^3 based on irritation to the eyes and nose, in addition to adverse CNS effects in humans at concentrations of 40 ppm (Anderson et al. 1983). An uncertainty factor of 100 was used to develop the subchronic RfC.

The National Research Council's Committee on Toxicology has set a one-hour Emergency Exposure Guidance Level (EEGL), for toluene at 200 ppm (800 mg/m^3) (NRC 1987). Formerly known as just EEL, the EEGL is defined as a ceiling limit for an unpredicted single exposure lasting one to 24 hours whose occurrence is expected to be rare in the lifetime of any person. It is designed to avoid substantial decrements in performance during emergencies and takes into account the statistical likelihood of a non-incapacitative, reversible effect in exposed populations (NRC 1987). A health criterion for acute inhalation exposure to toluene of 80 mg/m^3 can be derived from the EEGL by combining it with a safety factor of 10 to account for the healthy worker effect which assumes employed persons are generally healthier than the general population.

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METHYLENE CHLORIDE (Dichloromethane)

Methylene chloride is absorbed following oral and inhalation exposure. In experimental animals, oral absorption is approximately 98 percent (ATSDR 1992). The amount of airborne methylene chloride absorbed following inhalation exposure increases in direct proportion to its concentration in inspired air, the duration of exposure, and physical activity. Dermal absorption has not been accurately measured (EPA 1985a). Acute human exposure to methylene chloride may result in irritation of eyes, skin, and respiratory tract; central nervous system depression; elevated carboxyhemoglobin levels; and circulatory disorders that may be fatal (EPA 1980). In humans, single exposure to methylene chloride at 300 ppm caused decreased visual and auditory function (Fodor and Winneke 1971; Winneke 1974). Chronic exposure of animals to oral doses as low as 55 mg/kg/day has resulted in cellular changes in the liver (ATSDR 1992; NCA 1982). Animals subchronically exposed to vapor concentrations as low as 25 ppm exhibited histopathological changes in the liver and kidney (ATSDR 1992). Similar effects were seen in rats chronically exposed to 500 ppm (Nitschke et al. 1988). Studies in animals demonstrated that methylene chloride crosses the placental barrier (Anders and Sunram 1982); however, inhalation exposure to concentrations up to 1,250 ppm by pregnant mice and rats during gestation resulted in an increase of minor skeletal variations (delayed ossifications) in the fetuses (Schwetz et al. 1975). Methylene chloride is mutagenic for *Salmonella typhimurium* and produces mitotic recombination in yeast (EPA 1992). Several inhalation studies (at levels of 1,000 to 2,000 ppm methylene chloride) conducted in animals demonstrated that methylene chloride is carcinogenic inducing tumors of the mammary gland, liver and lung (NTP 1986). There is only suggestive evidence in experimental animals that hepatocellular carcinomas and neoplastic nodules arise from oral exposure (EPA 1985a,b; NCA 1983).

EPA (1993) classified methylene chloride in Group B2--Probable Human Carcinogen. It has been concluded by EPA (1985b) that the induction of distant site tumors from inhalation exposure and the borderline significance for induction of tumors in a drinking water study are an adequate basis for concluding that methylene chloride be considered a probable human carcinogen via ingestion as well as inhalation. EPA (1993) derived an inhalation unit risk of 4.7×10^{-7} $(\mu g/m^3)^{-1}$ based on the results of a National Toxicology Program (NTP) inhalation bioassay conducted in rats and mice (NTP 1986). Mammary tumors were noted in rats, while lung and liver tumors were observed in mice. EPA (1993) determined an oral cancer slope factor of 7.5×10^{-3} $(mg/kg/day)^{-1}$ based on the results of the NTP (1986) inhalation bioassay and on an ingestion bioassay conducted by the National Coffee Association (NCA 1983). In the NCA study, hepatocellular adenomas and/or carcinomas were observed in male mice. An oral reference dose (RfD) of 6×10^{-2} mg/kg/day has been developed for both chronic (EPA 1993) and subchronic (1992) exposures, based on a 2-year rat drinking water bioassay (NCA 1982) that identified no-observed-effect levels (NOELs) of 5.85 and 6.47 mg/kg/day for male and female rats, respectively. Liver toxicity was observed at doses of 52.58 and 58.32 mg/kg/day for males and females, respectively. An uncertainty factor of 100 was used to derive both the RfDs. EPA (1992) has established an inhalation RfC of 3 mg/m^3 for both chronic and subchronic exposures based on a study by Nitschke et al. (1988) in which rats were exposed to 200 ppm (694.8 mg/m^3) for 2 years. This study identified a NOAEL for liver toxicity. A safety factor of 100 was used to derive both RfCs. The chronic inhalation RfC is currently undergoing verification by EPA (1993).

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4-METHYL PHENOL (P-CRESOL)

Experimental evidence indicates that 4-methyl phenol is absorbed following ingestion and inhalation (EPA 1984) and also after dermal exposure (NIOSH 1978). Effects following acute exposure to 4-methyl phenol include muscular weakness; gastroenteric disturbances; severe depression; edema of the lungs; and injury to the eyes, skin, kidneys, liver, pancreas, spleen, and vascular system (Deichmann and Keplinger 1981; NIOSH 1978). Effects in rats following subchronic exposure (to doses ranging from 50-600 mg/kg/day) to 4-methyl phenol include increased mortality; reduction in body weight; increased kidney-to-body weight and liver-to-body weight ratios; and CNS effects such as salivation, rapid respiration, lethargy, ataxia, coma, dyspnea, tremors, diarrhea, and convulsions (EPA 1986, 1987). Lysol, a cresol-containing solution produces extensive hemolysis, erosion of blood vessels, kidney tubular damage, and liver necrosis in humans following intravaginal application to induce abortion (Vance 1945; Presley and Brown 1956). There is limited evidence that the dermal application of 4-methyl phenol promotes benign skin papillomas in mice following application of a tumor initiator (DMBA) (EPA 1993). Studies on the induction of unscheduled DNA synthesis showed p-cresol to be positive in human lung fibroblast cells in the presence of hepatic homogenates (Crowley and Margard 1978).

EPA (1993) established a weight-of-evidence classification for 4-methyl phenol of C (Possible Human Carcinogen) based on an increased incidence of skin papillomas in mice in an initiation-promotion study. In addition, the three cresol isomers produced positive results in genetic toxicity studies both alone or in combination. EPA (1992) derived an oral reference dose of 5×10^{-2} mg/kg/day based on decreased body weights and neurotoxicity in rats administered 4-methyl phenol by gavage (EPA 1986, 1987). A safety factor of 1,000 was used to derive the RfD.

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CHLOROMETHANE (Methyl Chloride)

Chloromethane is primarily absorbed by inhalation, although some is absorbed through the skin (NIOSH 1977). The compound is widely distributed in the body and rapidly metabolized and excreted within 24 hours of exposure. Acute exposure to humans produced primarily central nervous system (CNS) effects including headache, drowsiness, giddiness, ataxia, convulsions; hepatic and renal effects, depression of bone marrow activity, coma, and respiratory failure have also been observed (ACGIH 1986). Symptoms may develop a few hours after exposure to chloromethane. Chronic effects of chloromethane exposure include blurred vision, dizziness, weakness, gastrointestinal disturbances with prolonged vomiting, sleep disturbances, muscular incoordination, and tachycardia (Hansen et al. 1953). Chronic exposure in animals was reported to produce neuromuscular, liver, kidney, and testicular damage and death (Evtushenko 1966; Mitchell et al. 1979; Smith and Von Oettingen 1947). Chloromethane has produced teratogenic effects in the form of heart defects in the offspring of exposed mice (CIIT 1981a). There is suggestive evidence that chloromethane is carcinogenic in experimental animals. Male mice exposed by inhalation for 24 months developed tumors of the kidney and liver (CIIT 1981b).

EPA (1995) has classified chloromethane in Group C (Possible Human Carcinogen) and has developed an inhalation unit risk and oral slope factor for chloromethane based on kidney tumor data in male mice exposed via inhalation for 24 months (CIIT 1981b). EPA (1995) also calculated an oral cancer slope factor of 1.3×10^{-2} $(mg/kg/day)^{-1}$ based on route to route extrapolation from data obtained in the CIIT (1981b) study.

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APPENDIX C

BIOCONCENTRATION FACTOR CALCULATIONS

BIOCONCENTRATION FACTOR CALCULATIONS for ORGANIC CHEMICALS at POINT LONELY

CALCULATION OF Bv FOR ORGANIC CHEMICALS IN SOIL				
COC	log Kow	1.588 - 0.578 log Kow	log Bv	Bv
DRPH	5.30	-1.475	-1.475	0.033
GRPH[a]				
Benzene	2.69	0.033	0.033	1.079
Tetrachloroethene	2.53	0.126	0.126	1.336
Xylenes (total)[b]	2.77	-0.013	-0.013	0.970

[a]GRPH data limited; uptake and bioconcentration expected to be low.

[b] log Kow for ortho-xylene used

APPENDIX D

CONTAMINANT CONCENTRATION IN FOOD CALCULATIONS

CONTAMINANT CONCENTRATION IN FOOD CALCULATIONS for POINT LONELY

PLANT UPTAKE AND DIETARY PROPORTION OF VEGETATION CALCULATIONS
CF = CS*Bv*%V

INSTALLATION Point Lonely SPECIES brown lemming COC	COC Concentration Soil/Sediment (CS) mg/kg	Bioconcentration Factor (Bv) unitless	Proportion of vegetation in diet (%V) %	COC Concentration in food (CF) mg/kg
Inorganics				
Iron	0.00	0.004	0.50	0.000
Manganese	0.00	0.250	0.50	0.000
Organics				
DRPH	380.00	0.033	0.50	6.358
GRPH	0.00	0.000	0.50	0.000
Benzene	0.10	1.079	0.50	0.054
Tetrachloroethene	0.27	1.336	0.50	0.180
Xylenes (total)	0.28	0.970	0.50	0.136

CONTAMINANT CONCENTRATION IN FOOD CALCULATIONS for POINT LONELY

PLANT UPTAKE AND DIETARY PROPORTION OF VEGETATION CALCULATIONS CF = CS*Bv*%V				
INSTALLATION Point Lonely **SPECIES** caribou **COC**	**COC Concentration Soil/Sediment (CS)** **mg/kg**	**Bioconcentration Factor (Bv)** **unitless**	**Proportion of vegetation in diet (%V)** **%**	**COC Concentration in food (CF)** **mg/kg**
Inorganics				
Iron	0.00	0.004	0.01	0.000
Manganese	0.00	0.250	0.01	0.000
Organics				
DRPH	380.00	0.033	0.01	0.127
GRPH	0.00	0.000	0.01	0.000
Benzene	0.10	1.079	0.01	0.001
Tetrachloroethene	0.27	1.336	0.01	0.004
Xylenes (total)	0.28	0.970	0.01	0.003

CONTAMINANT CONCENTRATION IN FOOD CALCULATIONS for POINT LONELY

PLANT UPTAKE AND DIETARY PROPORTION OF VEGETATION CALCULATIONS

CF = CS*Bv*%V

INSTALLATION Point Lonely / SPECIES Lapland longspur / COC	COC Concentration Soil/Sediment (CS) mg/kg	Bioconcentration Factor (Bv) unitless	Proportion of vegetation in diet (%V) %	COC Concentration in food (CF) mg/kg
Inorganics				
Iron	0.00	0.004	0.20	0.000
Manganese	0.00	0.250	0.20	0.000
Organics				
DRPH	380.00	0.033	0.20	2.543
GRPH	0.00	0.000	0.20	0.000
Benzene	0.10	1.079	0.20	0.022
Tetrachloroethene	0.27	1.336	0.20	0.072
Xylenes (total)	0.28	0.970	0.20	0.054

CONTAMINANT CONCENTRATION IN FOOD CALCULATIONS for POINT LONELY

PLANT UPTAKE AND DIETARY PROPORTION OF VEGETATION CALCULATIONS

CF = CS*Bv*%V

INSTALLATION Point Lonely / SPECIES glaucous gull / COC	COC Concentration Soil/Sediment (CS) mg/kg	Bioconcentration Factor (Bv) unitless	Proportion of vegetation in diet (%V) %	COC Concentration in food (CF) mg/kg
Inorganics				
Iron	0.00	0.004	0.01	0.000
Manganese	0.00	0.250	0.01	0.000
Organics				
DRPH	380.00	0.033	0.01	0.127
GRPH	0.00	0.000	0.01	0.000
Benzene	0.10	1.079	0.01	0.001
Tetrachloroethene	0.27	1.336	0.01	0.004
Xylenes (total)	0.28	0.970	0.01	0.003

CONTAMINANT CONCENTRATION IN FOOD CALCULATIONS for POINT LONELY

PLANT UPTAKE AND DIETARY PROPORTION OF VEGETATION CALCULATIONS
CF = CS*Bv*%V

INSTALLATION Point Lonely / SPECIES brant / COC	COC Concentration Soil/Sediment (CS) mg/kg	Bioconcentration Factor (Bv) unitless	Proportion of vegetation in diet (%V) %	COC Concentration in food (CF) mg/kg
Inorganics				
Iron	0.00	0.004	0.03	0.000
Manganese	0.00	0.250	0.03	0.000
Organics				
DRPH	380.00	0.033	0.03	0.382
GRPH	0.00	0.000	0.03	0.000
Benzene	0.10	1.079	0.03	0.003
Tetrachloroethene	0.27	1.336	0.03	0.011
Xylenes (total)	0.28	0.970	0.03	0.008

CONTAMINANT CONCENTRATION IN FOOD CALCULATIONS for POINT LONELY

PLANT UPTAKE AND DIETARY PROPORTION OF VEGETATION CALCULATIONS

CF = CS*Bv*%V

INSTALLATION Point Lonely / SPECIES pectoral sandpiper / COC	COC Concentration Soil/Sediment (CS) mg/kg	Bioconcentration Factor (Bv) unitless	Proportion of vegetation in diet (%V) %	COC Concentration in food (CF) mg/kg
Inorganics				
Iron	0.00	0.004	1.00	0.000
Manganese	0.00	0.250	1.00	0.000
Organics				
DRPH	380.00	0.033	1.00	12.717
GRPH	0.00	0.000	1.00	0.000
Benzene	0.10	1.079	1.00	0.108
Tetrachloroethene	0.27	1.336	1.00	0.361
Xylenes (total)	0.28	0.970	1.00	0.272

CONTAMINANT CONCENTRATION IN FOOD CALCULATIONS for POINT LONELY

PLANT UPTAKE AND DIETARY PROPORTION OF VEGETATION CALCULATIONS

CF = CS*Bv*%V

INSTALLATION: Point Lonely SPECIES: spectacled eider COC	COC Concentration Soil/Sediment (CS) mg/kg	Bioconcentration Factor (Bv) unitless	Proportion of vegetation in diet (%V) %	COC Concentration in food (CF) mg/kg
Inorganics				
Iron	0.00	0.004	0.25	0.000
Manganese	0.00	0.250	0.25	0.000
Organics				
DRPH	380.00	0.033	0.25	3.179
GRPH	0.00	0.000	0.25	0.000
Benzene	0.10	1.079	0.25	0.027
Tetrachloroethene	0.27	1.336	0.25	0.090
Xylenes (total)	0.28	0.970	0.25	0.068

APPENDIX E

ESTIMATED EXPOSURE EQUATIONS

ESTIMATED EXPOSURE EQUATION FOR BIRDS AND MAMMALS at POINT LONELY

Estimated Exposure = ({[(CF*FI) + (CS*SI*ROA) + (CW*WI)] *.001}* IS) / BW

INSTALLATION Point Lonely SPECIES arctic fox	COC Conc. in Food (CF)*	Food Intake Rate (FI)	(CF*FI)	Soil/Sed. Intake % (SI%)	Soil/Sed. Ingestion Rate (SI)	COC Conc. Soil /Sed. (CS)	Relative Oral Availability (ROA)	(SI*CS*ROA)	COC Conc. Water (CW)	Water Intake Rate (WI)	(CW*WI)	(A+B+C)	Conver. Units 0.0010	Percent Ingested at Site (IS)	Body Weight (BW)	ESTIMATED EXPOSURE (D*IS/BW=EE)
COC	(mg/kg)	(g/day)	(A)	% of FI	(g/day)	(mg/kg)	(unitless)	(B)	(ug/L)	(L/day)	(C)	(D)	(D)*.001	(unitless)	(kg)	(mg/kg-bw/day)
Inorganics																
Iron		256	0.00	0.028	7.17	0.00	1	0.00	3000.00	0.42	1260	1260.00	1.26	0.02	4.95	0.0051
Manganese		256	0.00	0.028	7.17	0.00	1	0.00	620.00	0.42	260.4	260.40	0.26	0.02	4.95	0.0011
Organics																
DRPH		256	0.00	0.028	7.17	380.00	1	2723.84	0.00	0.42	0	2723.84	2.72	0.02	4.95	0.0110
GRPH		256	0.00	0.028	7.17	0.00	1	0.00	140.00	0.42	58.8	58.80	0.06	0.02	4.95	0.0002
Benzene		256	0.00	0.028	7.17	0.10	1	0.72	0.00	0.42	0	0.72	0.00	0.02	4.95	0.0000
Tetrachloroethene		256	0.00	0.028	7.17	0.27	1	1.94	230.00	0.42	96.6	98.54	0.10	0.02	4.95	0.0004
Xylenes (total)		256	0.00	0.028	7.17	0.28	1	2.01	0.00	0.42	0	2.01	0.00	0.02	4.95	0.0000

*Concentration in Food cannot be calculated for the arctic fox because COC data are not available for animal portion of trophic web.

ESTIMATED EXPOSURE EQUATION FOR BIRDS AND MAMMALS at POINT LONELY

Estimated Exposure = ({[(CF*FI) + (CS*SI*ROA) + (CW*WI)] *.001}* IS) / BW

INSTALLATION: Point Lonely; SPECIES: brown lemming	COC Conc. in Food (CF)*	Food Intake Rate (FI)	(CF*FI)	Soil/Sed. Intake % (SI%)	COC Conc. Soil /Sed. (CS)	Soil/Sed. Ingestion Rate (SI)	Relative Oral Availability (ROA)	(CS*SI*ROA)	COC Conc. Water (CW)	Water Intake Rate (WI)	(CW*WI)	(A+B+C)	Conver. Units 0.0010	Percent Ingested at Site (IS)	Body Weight (BW)	ESTIMATED EXPOSURE (D*IS/BW=EE)
COC	(mg/kg)	(g/day)	(A)	% of FI	(mg/kg)	(g/day)	(unitless)	(B)	(ug/L)	(L/day)	(C)	(D)	(D)*.001	(unitless)	(kg)	(mg/kg-bw/day)
Inorganics																
Iron	0.00	45	0.00	0.027	0.00	1.22	1	0.00	3000.00	0.007	21	21.00	0.02	0.5	0.055	0.1909
Manganese	0.00	45	0.00	0.027	0.00	1.22	1	0.00	620.00	0.007	4.34	4.34	0.00	0.5	0.055	0.0395
Organics				0.027												
DRPH	6.36	45	286.13	0.027	380.00	1.22	1	461.70	0.00	0.007	0	747.83	0.75	0.5	0.055	6.7985
GRPH	0.00	45	0.00	0.027	0.00	1.22	1	0.00	140.00	0.007	0.98	0.98	0.00	0.5	0.055	0.0089
Benzene	0.05	45	2.43	0.027	0.10	1.22	1	0.12	0.00	0.007	0	2.55	0.00	0.5	0.055	0.0232
Tetrachloroethene	0.18	45	8.11	0.027	0.27	1.22	1	0.33	230.00	0.007	1.61	10.05	0.01	0.5	0.055	0.0914
Xylenes (total)	0.14	45	6.11	0.027	0.28	1.22	1	0.34	0.00	0.007	0	6.45	0.01	0.5	0.055	0.0587

ESTIMATED EXPOSURE EQUATION FOR BIRDS AND MAMMALS at POINT LONELY

Estimated Exposure = ({[(CF*FI) + (CS*SI*ROA) + (CW*WI)] *.001}* IS) / BW

INSTALLATION Point Lonely SPECIES caribou	COC Conc. in Food (CF)*	Food Intake Rate (FI)	(CF*FI)	Soil/Sed. Intake % (SI%)	COC Conc. Soil /Sed. (CS)	Soil/Sed. Ingestion Rate (SI)	Relative Oral Availability (ROA)	(CS*SI*ROA)	COC Conc. Water (CW)	Water Intake Rate (WI)	(CW*WI)	(A+B+C)	Conver. Units 0.0010	Percent Ingested at Site (IS)	Body Weight (BW)	ESTIMATED EXPOSURE (D*IS/BW=EE)
COC	(mg/kg)	(g/day)	(A)	% of FI	(mg/kg)	(g/day)	(unitless)	(B)	(ug/L)	(L/day)	(C)	(D)	(D)*.001	(unitless)	(kg)	(mg/kg-bw/day)
Inorganics																
Iron	0.000	2400	0.00	0.02	0.00	48	1	0.00	3000.00	6.0	18000	18000.00	18.00	0.01	95.5	0.0019
Manganese	0.000	2400	0.00	0.02	0.00	48	1	0.00	620.00	6.0	3720	3720.00	3.72	0.01	95.5	0.0004
Organics																
DRPH	0.127	2400	305.21	0.02	380.00	48	1	18240.00	0.00	6.0	0	18545.21	18.55	0.01	95.5	0.0019
GRPH	0.000	2400	0.00	0.02	0.00	48	1	0.00	140.00	6.0	840	840.00	0.84	0.01	95.5	0.0001
Benzene	0.001	2400	2.59	0.02	0.10	48	1	4.80	0.00	6.0	0	7.39	0.01	0.01	95.5	0.0000
Tetrachloroethene	0.004	2400	8.65	0.02	0.27	48	1	12.96	230.00	6.0	1380	1401.61	1.40	0.01	95.5	0.0001
Xylenes (total)	0.003	2400	6.52	0.02	0.28	48	1	13.44	0.00	6.0	0	19.96	0.02	0.01	95.5	0.0000

ESTIMATED EXPOSURE EQUATION FOR BIRDS AND MAMMALS at POINT LONELY

Estimated Exposure = ({[(CF*FI) + (CS*SI*ROA) + (CW*WI)] *.001}* IS) / BW

INSTALLATION: Point Lonely; SPECIES: Lapland longspur	COC Conc. in Food (CF)*	Food Intake Rate (FI)	(CF*FI)	Soil/Sed. Intake % (SI%)	COC Conc. Soil /Sed. (CS)	Soil/Sed. Ingestion Rate (SI)	Relative Oral Availability (ROA)	(CS*SI*ROA)	COC Conc. Water (CW)	Water Intake Rate (WI)	(CW*WI)	(A+B+C)	Conver. Units 0.0010	Percent Ingested at Site (IS)	Body Weight (BW)	ESTIMATED EXPOSURE (D*IS/BW=EE)
COC	(mg/kg)	(g/day)	(A)	% of FI	(mg/kg)	(g/day)	(unitless)	(B)	(ug/L)	(L/day)	(C)	(D)	(D)*.001	(unitless)	(kg)	(mg/kg-bw/day)
Inorganics																
Iron	0.00	6.6	0.00	0.02	0.00	0.13	1	0.00	3000.00	0.005	15.00	15.00	0.02	0.5	0.027	0.2778
Manganese	0.00	6.6	0.00	0.02	0.00	0.13	1	0.00	620.00	0.005	3.10	3.10	0.00	0.5	0.027	0.0574
Organics																
DRPH	2.54	6.6	16.79	0.02	380.00	0.13	1	50.16	0.00	0.005	0.00	66.95	0.07	0.5	0.027	1.2397
GRPH	0.00	6.6	0.00	0.02	0.00	0.13	1	0.00	140.00	0.005	0.70	0.70	0.00	0.5	0.027	0.0130
Benzene	0.02	6.6	0.14	0.02	0.10	0.13	1	0.01	0.00	0.005	0.00	0.16	0.00	0.5	0.027	0.0029
Tetrachloroethene	0.07	6.6	0.48	0.02	0.27	0.13	1	0.04	230.00	0.005	1.15	1.66	0.00	0.5	0.027	0.0308
Xylenes (total)	0.05	6.6	0.36	0.02	0.28	0.13	1	0.04	0.00	0.005	0.00	0.40	0.00	0.5	0.027	0.0073

ESTIMATED EXPOSURE EQUATION FOR BIRDS AND MAMMALS at POINT LONELY

Estimated Exposure = ({[(CF*FI) + (CS*SI*ROA) + (CW*WI)] *.001}* IS) / BW

INSTALLATION: Point Lonely; SPECIES: glaucous gull	COC Conc. in Food (CF)*	Food Intake Rate (FI)	(CF*FI)	Soil/Sed. Intake % (SI%)	COC Conc. Soil /Sed. (CS)	Soil/Sed. Ingestion Rate (SI)	Relative Oral Availability (ROA)	(CS*SI*ROA)	COC Conc. Water (CW)	Water Intake Rate (WI)	(CW*WI)	(A+B+C)	Conver. Units 0.0010	Percent Ingested at Site (IS)	Body Weight (BW)	ESTIMATED EXPOSURE (D*IS/BW=EE)
COC	(mg/kg)	(g/day)	(A)	% of FI	(mg/kg)	(g/day)	(unitless)	(B)	(ug/L)	(L/day)	(C)	(D)	(D)*.001	(unitless)	(kg)	(mg/kg-bw/day)
Inorganics																
Iron	0.00	73.9	0.00	0.076	0.00	5.62	1	0.00	3000.00	0.08	240.00	240.00	0.24	0.06	1.45	0.0099
Manganese	0.00	73.9	0.00	0.076	0.00	5.62	1	0.00	620.00	0.08	49.60	49.60	0.05	0.06	1.45	0.0021
Organics																
DRPH	0.13	73.9	9.40	0.076	380.00	5.62	1	2134.23	0.00	0.08	0.00	2143.63	2.14	0.06	1.45	0.0887
GRPH	0.00	73.9	0.00	0.076	0.00	5.62	1	0.00	140.00	0.08	11.20	11.20	0.01	0.06	1.45	0.0005
Benzene	0.00	73.9	0.08	0.076	0.10	5.62	1	0.56	0.00	0.08	0.00	0.64	0.00	0.06	1.45	0.0000
Tetrachloroethene	0.00	73.9	0.27	0.076	0.27	5.62	1	1.52	230.00	0.08	18.40	20.18	0.02	0.06	1.45	0.0008
Xylenes (total)	0.00	73.9	0.20	0.076	0.28	5.62	1	1.57	0.00	0.08	0.00	1.77	0.00	0.06	1.45	0.0001

ESTIMATED EXPOSURE EQUATION FOR BIRDS AND MAMMALS at POINT LONELY

Estimated Exposure = ({[(CF*FI) + (CS*SI*ROA) + (CW*WI)] *.001}* IS) / BW

INSTALLATION: Point Lonely SPECIES: brant COC	COC Conc. in Food (CF)* (mg/kg)	Food Intake Rate (FI) (g/day)	(CF*FI) (A)	Soil/Sed. Intake % (SI%) % of FI	COC Conc. Soil /Sed. (CS) (mg/kg)	Soil/Sed. Ingestion Rate (SI) (g/day)	Relative Oral Availability (ROA) (unitless)	(CS*SI*ROA) (B)	COC Conc. Water (CW) (ug/L)	Water Intake Rate (WI) (L/day)	(CW*WI) (C)	(A+B+C) (D)	Conver. Units 0.0010 (D)*.001	Percent Ingested at Site (IS) (unitless)	Body Weight (BW) (kg)	ESTIMATED EXPOSURE (D*IS/BW=EE) (mg/kg-bw/day)
Inorganics																
Iron	0.00	69.2	0.00	0.082	0.00	5.67	1	0.00	3000.00	0.07	210	210.00	0.21	0.38	1.31	0.0609
Manganese	0.00	69.2	0.00	0.082	0.00	5.67	1	0.00	620.00	0.07	43.4	43.40	0.04	0.38	1.31	0.0126
Organics																
DRPH	0.38	69.2	26.40	0.082	380.00	5.67	1	2156.27	0.00	0.07	0	2182.67	2.18	0.38	1.31	0.6331
GRPH	0.00	69.2	0.00	0.082	0.00	5.67	1	0.00	140.00	0.07	9.8	9.80	0.01	0.38	1.31	0.0028
Benzene	0.00	69.2	0.22	0.082	0.10	5.67	1	0.57	0.00	0.07	0	0.79	0.00	0.38	1.31	0.0002
Tetrachloroethene	0.01	69.2	0.75	0.082	0.27	5.67	1	1.53	230.00	0.07	16.1	18.38	0.02	0.38	1.31	0.0053
Xylenes (total)	0.01	69.2	0.56	0.082	0.28	5.67	1	1.59	0.00	0.07	0	2.15	0.00	0.38	1.31	0.0006

ESTIMATED EXPOSURE EQUATION FOR BIRDS AND MAMMALS at POINT LONELY

Estimated Exposure = ({[(CF*FI) + (CS*SI*ROA) + (CW*WI)] *.001}* IS) / BW

INSTALLATION Point Lonely SPECIES pectoral sandpiper	COC Conc. in Food (CF)*	Food Intake Rate (FI)	(CF*FI)	Soil/Sed. Intake % (SI%)	COC Conc. Soil /Sed. (CS)	Soil/Sed. Ingestion Rate (SI)	Relative Oral Availability (ROA)	(CS*SI*ROA)	COC Conc. Water (CW)	Water Intake Rate (WI)	(CW*WI)	(A+B+C)	Conver. Units 0.0010	Percent Ingested at Site (IS)	Body Weight (BW)	ESTIMATED EXPOSURE (D*IS/BW=EE)
COC	(mg/kg)	(g/day)	(A)	% of FI	(mg/kg)	(g/day)	(unitless)	(B)	(ug/L)	(L/day)	(C)	(D)	(D)*.001	(unitless)	(kg)	(mg/kg-bw/day)
Inorganics																
Iron	0.00	11.1	0.00	0.181	0.00	2.01	1	0.00	3000.00	0.01	30	30.00	0.03	1.00	0.08	0.3750
Manganese	0.00	11.1	0.00	0.181	0.00	2.01	1	0.00	620.00	0.01	6.2	6.20	0.01	1.00	0.08	0.0775
Organics																
DRPH	12.72	11.1	141.16	0.181	380.00	2.01	1	763.46	0.00	0.01	0	904.62	0.90	1.00	0.08	11.3077
GRPH	0.00	11.1	0.00	0.181	0.00	2.01	1	0.00	140.00	0.01	1.4	1.40	0.00	1.00	0.08	0.0175
Benzene	0.11	11.1	1.20	0.181	0.10	2.01	1	0.20	0.00	0.01	0	1.40	0.00	1.00	0.08	0.0175
Tetrachloroethene	0.36	11.1	4.00	0.181	0.27	2.01	1	0.54	230.00	0.01	2.3	6.85	0.01	1.00	0.08	0.0856
Xylenes (total)	0.27	11.1	3.02	0.181	0.28	2.01	1	0.56	0.00	0.01	0	3.58	0.00	1.00	0.08	0.0447

ESTIMATED EXPOSURE EQUATION FOR BIRDS AND MAMMALS at POINT LONELY

Estimated Exposure = ({[(CF*FI) + (CS*SI*ROA) + (CW*WI)] *.001}* IS) / BW

INSTALLATION: Point Lonely; SPECIES: spectacled eider	COC Conc. in Food (CF)*	Food Intake Rate (FI)	(CF*FI)	Soil/Sed. Intake % (SI%)	COC Conc. Soil /Sed. (CS)	Soil/Sed. Ingestion Rate (SI)	Relative Oral Availability (ROA)	(CS*SI*ROA)	COC Conc. Water (CW)	Water Intake Rate (WI)	(CW*WI)	(A+B+C)	Conver. Units 0.0010	Percent Ingested at Site (IS)	Body Weight (BW)	ESTIMATED EXPOSURE (D*IS/BW=EE)
COC	(mg/kg)	(g/day)	(A)	% of FI	(mg/kg)	(g/day)	(unitless)	(B)	(ug/L)	(L/day)	(C)	(D)	(D)*.001	(unitless)	(kg)	(mg/kg-bw/day)
Inorganics																
Iron	0.00	71.6	0.00	0.082	0.00	5.87	1	0.00	3000.00	0.07	210	210.00	0.21	0.02	1.375	0.0031
Manganese	0.00	71.6	0.00	0.082	0.00	5.87	1	0.00	620.00	0.07	43.4	43.40	0.04	0.02	1.375	0.0006
Organics																
DRPH	3.18	71.6	227.63	0.082	380.00	5.87	1	2231.06	0.00	0.07	0	2458.69	2.46	0.02	1.375	0.0358
GRPH	0.00	71.6	0.00	0.082	0.00	5.87	1	0.00	140.00	0.07	9.8	9.80	0.01	0.02	1.375	0.0001
Benzene	0.03	71.6	1.93	0.082	0.10	5.87	1	0.59	0.00	0.07	0	2.52	0.00	0.02	1.375	0.0000
Tetrachloroethene	0.09	71.6	6.45	0.082	0.27	5.87	1	1.59	230.00	0.07	16.1	24.14	0.02	0.02	1.375	0.0004
Xylenes (total)	0.07	71.6	4.86	0.082	0.28	5.87	1	1.64	0.00	0.07	0	6.51	0.01	0.02	1.375	0.0001

APPENDIX F

SCALING FACTOR CALCULATIONS

SCALING FACTOR CALCULATIONS for POINT LONELY ERA

Scaling factor (SF) = (representative species average body weight/ test species average body weight)$^{1/3}$
based on the mass to surface area ratios of the test species and the representative species
(Mantel and Schneiderman 1975)

Representative Species	Average Body Weight (kg)	Test Species	Average Body Weight (kg)	Scaling Factor (SF)
brown lemming	0.055	mouse	0.025	1.30
	0.055	rat	0.25	0.60
arctic fox	4.95	mouse	0.025	5.82
	4.95	rat	0.25	2.70
	4.95	mink	1.0	1.70
caribou	95.5	sheep	60	1.17
	95.5	cattle	500	0.58
	95.5	rat	0.25	7.24
	95.5	mouse	0.025	15.59
Lapland longspur	0.027	chicken	0.8	0.32
	0.027	mallard	1.08	0.29
	0.027	Japanese quail	0.10	0.65
	0.027	ringed dove	0.155	0.56
	0.027	ring-necked pheasant	1.14	0.29
brant	1.305	chicken	0.8	1.18
	1.305	mallard	1.08	1.07
	1.305	Japanese quail	0.10	2.35
	1.305	ringed dove	0.155	2.03
	1.305	ring-necked pheasant	1.14	1.05
glaucous gull	1.445	chicken	0.8	1.22
	1.445	mallard	1.08	1.10
	1.445	Japanese quail	0.10	2.43
	1.445	ringed dove	0.155	2.10
	1.445	ring-necked pheasant	1.14	1.08
pectoral sandpiper	0.079	chicken	0.8	0.46
	0.079	mallard	1.08	0.42
	0.079	Japanese quail	0.10	0.92
	0.079	ringed dove	0.155	0.80
	0.079	ring-necked pheasant	1.14	0.41
spectacled eider	1.375	chicken	0.8	1.20
	1.375	mallard	1.08	1.08
	1.375	Japanese quail	0.10	2.39
	1.375	ringed dove	0.155	2.07
	1.375	ring-necked pheasant	1.14	1.06

APPENDIX G

RI ANALYTICAL DATA

1

TABLE G-1. SUMMARY OF SAMPLING AND ANALYSES CONDUCT

ANALYSES	HVOC*	BTEX*	VOC 8260	SVOC	Metals[b]	TPH-Diesel[b] Range 3510/3550	TPH - R
ANALYTICAL METHOD	SW8010M	SW8020	SW8260	SW8270	SW3050 (Soil) 3005 (Water)/6010	Diesel 8100M	Gas 5C
POINT LONELY							
Background	3 Soil 2 Water	3 Soil 2 Water	3 Soil 2 Water	3 Soil 1 Water	3 Soil 2 Water (Total) 2 Water (Dissolved)	4 Soil 2 Water	3 2
Sewage Disposal Area (SS01)	NA	18 Soil 4 Water	3 Soil 2 Water	3 Soil 2 Water	NA	23 Soil 5 Water	1 4
Drum Storage Area(ST02)	8 Soil 5 Water	11 Soil 5 Water	1 Soil 1 Water	1 Soil 1 Water	1 Soil 1 Water (Total) 1 Water (Dissolved)	11 Soil 5 Water	1 5
Beach Diesel Tanks (SS03)	NA	7 Soil 2 Water	1 Soil 1 Water	1 Soil 1 Water	NA	7 Soil 2 Water	7 2
POL Storage (SS04)	NA	4 Soil 1 Water	1 Soil 1 Water	1 Water	1 Soil 1 Water (Total) 1 Water (Dissolved)	5 Soil	4 1
Diesel Spills (SS05)	NA	23 Soil 7 Water	1 Soil 1 Water	1 Soil 1 Water	NA	33 Soil 7 Water	2 7
Old Dump Site (LF07)	7 Soil 2 Water	7 Soil 2 Water	1 Soil 1 Water	1 Soil	1 Soil 1 Water (Total) 1 Water (Dissolved)	9 Soil 2 Water	7 2
Garage (SS09)	9 Soil 2 Water	9 Soil 2 Water	5 Soil 2 Water	2 Soil 2 Water	2 Soil 2 Water (Total) 2 Water (Dissolved)	9 Soil 2 Water	9 2
Diesel Tank (West of Hangar) (ST10)	NA	8 Soil 2 Water	2 Soil 1 Water	1 Soil 1 Water	NA	12 Soil 2 Water	8 2
Inactive Landfill (LF11) and Vehicle Storage Area (SS14)	7 Soil 3 Water	7 Soil 3 Water	1 Soil 1 Water	1 Soil 1 Water	1 Soil 1 Water (Total) 1 Water (Dissolved)	7 Soil 3 Water	7 3
Module Train (SS12)	NA	4 Soil 1 Water	1 Soil 1 Water	1 Soil 1 Water	NA	6 Soil 2 Water	4 1
Hangar Pad Area (SS13)	NA	4 Soil 3 Water	1 Soil 1 Water	1 Soil 1 Water	NA	7 Soil 3 Water	4 3
Total Analyses	34 Soil 14 Water	105 Soil 34 Water	21 Soil 15 Water	16 Soil 13 Water	9 Soil 8 Water (Total) 8 Water (Dissolved)	133 Soil 35 Water	10 34
QA/QC SAMPLES							
Trip Blanks	3 Water	4 Water	4 Water	NA	NA	NA	4
Equipment Blanks	6 Water	6 Water	6 Water	4 Water	4 Water (Total)	8 Water	8
Ambient Condition Blanks	2 Water	2 Water	NA	NA	NA	NA	2

NA Not analyzed.
* These analyses were completed on a quick turnaround basis.
a The number of soil samples includes sediment samples collected from surface water features.
b Some of these analyses were completed on a 24-hour turnaround at a temporary fixed laboratory at Barrow, Alaska.
d Investigation derived wastes from Point Lonely were combined with the investigation derived wastes from Point Lay, Point Barrow, a

(2)

ES CONDUCTED FOR POINT LONELY REMEDIAL INVESTIGATIONS[a]

esel[b] je 550 100M	TPH - Gasoline[b] Range Gas 5030/8015M	TPH Residual Range* Diesel 8100M	PCB* SW8080/8080M	Pesticides* SW8080/8080M	TDS E160.1	TSS E160.2	TOC SW9060	TOTAL SAMPLES[d]
il ter	3 Soil 2 Water	4 Soil 2 Water	3 Soil 2 Water	3 Soil 2 Water	2 Water	2 Water	3 Soil 2 Water	4 Soil 2 Water
oil ter	18 Soil 4 Water	23 Soil 5 Water	NA	NA	2 Water	2 Water	2 Water	23 Soil 5 Water
oil ter	11 Soil 5 Water	11 Soil 5 Water	8 Soil 5 Water	NA	1 Water	1 Water	1 Water	11 Soil 5 Water
oil ter	7 Soil 2 Water	7 Soil 2 Water	NA	NA	1 Water	1 Water	1 Water	7 Soil 2 Water
oil	4 Soil 1 Water	5 Soil	NA	NA	1 Water	1 Water	1 Soil 1 Water	5 Soil 1 Water
oil ter	26 Soil 7 Water	30 Soil 7 Water	NA	NA	1 Water	1 Water	1 Soil 1 Water	30 Soil 7 Water
oil ter	7 Soil 2 Water	9 Soil 2 Water	7 Soil 2 Water	NA	1 Water	1 Water	1 Soil 1 Water	9 Soil 2 Water
oil ter	9 Soil 2 Water	9 Soil 2 Water	5 Soil 2 Water	NA	NA	NA	NA	9 Soil 2 Water
oil ter	8 Soil 2 Water	12 Soil 2 Water	NA	NA	1 Water	1 Water	1 Water	12 Soil 2 Water
oil ter	7 Soil 3 Water	7 Soil 3 Water	7 Soil 3 Water	1 Soil	1 Water	1 Water	1 Water	7 Soil 3 Water
oil ter	4 Soil 1 Water	6 Soil 2 Water	NA	NA	1 Water	1 Water	1 Water	6 Soil 2 Water
oil ter	4 Soil 3 Water	7 Soil 3 Water	NA	NA	1 Water	1 Water	1 Soil 1 Water	7 Soil 3 Water
Soil ater	108 Soil 34 Water	130 Soil 35 Water	30 Soil 14 Water	4 Soil 2 Water	13 Water	13 Water	7 Soil 13 Water	130 Soil 36 Water
\	4 Water	NA	NA	NA	NA	NA	NA	4 Water
ater	8 Water	6 Water	4 Water	1 Water	NA	NA	4 Water	6 Water
\	2 Water	NA	NA	NA	NA	NA	NA	2 Water

a.

/, Point Barrow, and Wainwright. These were collectively sampled during the Point Barrow investigation.

(1)

TABLE G-1. SUMMARY OF SAMPLING AND ANALYSES CONDU(

ANALYSES	HVOC*	BTEX*	VOC 8260	SVOC	Metals[b]	TPH-Diesel[b] Range 3510/3550	TPI
ANALYTICAL METHOD	SW8010M	SW8020	SW8260	SW8270	SW3050 (Soil) 3005 (Water)/6010	Diesel 8100M	Gas
Field Replicates	4 Soil	11 Soil	3 Soil	2 Soil	1 Soil	11 Soil	
Field Duplicates	2 Water	4 Water	3 Water	3 Water	1 Water (Total) 1 Water (Dissolved)	4 Water	
Total Analyses with QA/QC	38 Soil 27 Water	116 Soil 50 Water	24 Soil 28 Water	18 Soil 20 Water	10 Soil 13 Water (Total) 9 Water (Dissolved)	144 Soil 47 Water	

NA Not analyzed.
* These analyses were completed on a quick turnaround basis.
a The number of soil samples includes sediment samples collected from surface water features.
b Some of these analyses were completed on a 24-hour turnaround at a temporary fixed laboratory at Barrow, Alaska.
d Investigation derived wastes from Point Lonely were combined with the investigation derived wastes from Point Lay, Point Barrow

2

ES CONDUCTED FOR POINT LONELY REMEDIAL INVESTIGATIONS[a]

iesel[b] ge i550	TPH - Gasoline[b] Range	TPH Residual Range*	PCB*	Pesticides*	TDS	TSS	TOC	TOTAL SAMPLES[d]
i100M	Gas 5030/8015M	Diesel 8100M	SW8080/8080M	SW8080/8080M	E160.1	E160.2	SW9060	
ioil	11 Soil	11 Soil	4 Soil	NA	NA	NA	1 Soil	11 Soil
iter	4 Water	4 Water	2 Water	1 Water	3 Water	3 Water	3 Water	4 Water
Soil ater	119 Soil 52 Water	141 Soil 45 Water	34 Soil 20 Water	4 Soil 4 Water	16 Water	16 Water	8 Soil 20 Water	141 Soil 52 Water

a.
y, Point Barrow, and Wainwright. These were collectively sampled during the Point Barrow investigation.

TABLE G-2. BACKGROUND ANALYTICAL DATA SUMMARY

Installation: Point Lonely
Site: Background (BKGD)
Matrix: Soil/Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Point Lonely Bkgd. Range	Environmental Samples				Field Blanks			Lab Blanks	
					S01	SD01	SD02	2SD03	AB01	EB02	TB02		
Laboratory Sample ID Numbers					699 4506-3	734 4504-6	700 4506-4	1773	908	694/696 4506-1	684 4505-3	#5-82793 #3&4-82593 4505/4506	#6-82693 #5-9693 #1&2-82893 4504/4506
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	19-33	190-330	500[a]	<190[b]-150J[b]	<190[b]	150J[b]	<330[b]	<300[b]	NA	<1,000[b]	NA	<1,000	<50
GRPH	2-3	20-30	100	<20J[b]-27J[b]	<20J[b]	27J[b]	<30J[b]	NA	<100J[b]	<100J[b]	<100J[b]	<50	<2
RRPH (Approx.)	18-67	180-670	2,000[a]	<180-<670	<380	<180	<670	<800	NA	<2,000	NA	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<1-2.7J	<1.0	2.7J	<1.5	NA					
Benzene	0.004-0.03	0.04-0.3	0.5	<0.04-<0.3	<0.2	<0.04	<0.3	NA	<1	<1	<1	<1	<0.02
Ethylbenzene	0.004-0.03	0.04-0.3		<0.2-0.5	<0.2	0.5	<0.3	NA	<1	<1	<1	<1	<0.02
Toluene	0.004-0.03	0.04-0.3		<0.2-0.2	<0.2	0.2	<0.3	NA	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.008-0.06	0.08-0.6		<0.4-2.0J	<0.4	2.0J	<0.6	NA	<2	<2	<2	<2	<0.04
HVOC 8010	0.004-0.03	0.04-0.3		<0.04-<0.3	<0.2	<0.04	<0.3	NA	<1	NA	<1	<1	<0.02
VOC 8260													
n-Butylbenzene	0.020	0.050-0.500		<0.300-0.218	<0.300	0.218	<0.500	NA	NA	<1	<1	<1	<0.020
sec-Butylbenzene	0.020	0.050-0.500		<0.300-0.136	<0.300	0.136	<0.500	NA	NA	<1	<1	<1	<0.020
Ethylbenzene	0.020	0.050-0.500		<0.300-0.362	<0.300	0.362	<0.500	NA	NA	<1	<1	<1	<0.020
Isopropylbenzene	0.020	0.050-0.500		<0.300-0.171	<0.300	0.171	<0.500	NA	NA	<1	<1	<1	<0.020
p-Isopropyltoluene	0.020	0.050-0.500		<0.300-0.107	<0.300	0.107	<0.500	NA	NA	<1	<1	<1	<0.020
Naphthalene	0.020	0.050-0.500		<0.300-0.211	<0.300	0.211	<0.500	NA	NA	<1	<1	<1	<0.020

☐ CT&E Data.
■ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-2. BACKGROUND ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Background (BKGD)

Matrix: Soil/Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Point Lonely Bkgd. Range	Environmental Samples				Field Blanks			Lab Blanks	
					S01	SD01	SD02	2SD03	AB01	EB02	TB02		
Laboratory Sample ID Numbers					699 4506-3	734 4504-6	700 4506-4	1773	906	694/696 4506-1	684 4505-3	#5-82793 4505/4506	#6-82693 #5-9693 4504/4506
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
n-Propylbenzene	0.020	0.050-0.500		<0.300-0.302	<0.300	0.302	<0.500	NA	NA	<1	<1	<1	<0.020
1,2,4-Trimethylbenzene	0.020	0.050-0.500		<0.300-0.956	<0.300	0.956	<0.500	NA	NA	<1	<1	<1	<0.020
1,3,5-Trimethylbenzene	0.020	0.050-0.500		<0.300-0.409	<0.300	0.409	<0.500	NA	NA	<1	<1	<1	<0.020
Xylenes (Total)	0.040	0.100-1.00		<0.600-2.267	<0.600	2.267	<1.00	NA	NA	<2	<2	<2	<0.040
SVOC 8270	0.200	5.00-30.0		<5.00-<30.0	<20.0	<5.00	<30.0	NA	NA	<10.2	NA	<10	<0.200
PCBs	0.01-0.07	0.1-0.7	10	<0.1-<0.7	<0.4	<0.1	<0.7	NA	NA	<2	NA	<2	NA
Pesticides	0.002-0.05	0.02-0.5		<0.02J-<0.5J	<0.04J-<0.5J	<0.02J-<0.5J	<0.07J-<0.5J	NA	NA	<0.2J-<10J	NA	NA	NA
TOC				99,600-473,000	355,000	99,600	473,000	NA	NA	<5,000	NA	<5,000	NA

□ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.

TABLE G-2. BACKGROUND ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Background (BKGD)
Matrix: Soil/Sediment
Units: mg/kg
METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Point Lonely Bkgd. Range	Environmental Samples			Field Blank			Lab Blanks
						S01	SD01	SD02		EB02		
Laboratory Sample ID Numbers						4506-3	4504-6	4506-4		4506-1		4504 4506
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		µg/L		µg/L
Aluminum	0.35	2		1,500-25,000	3,600-25,000	3,600	25,000	5,050		<100		108
Antimony	N/A	49-130		<7.8-<230	<49-<130	<84	<49	<130		<100		<100
Arsenic	0.11	4.9-13		<4.9-8.5	<4.9-<13	<8.4	<4.9	<13		<100		<100
Barium	0.024	1		27-390	165-370	165	370	284		<50		<50
Beryllium	N/A	4.2-25		<2.6-6.4	<4.2-<25	<4.2	<25	<6.4		<50		<50
Cadmium	0.33	4.2J-25		<3.0-<36	<4.2J-<25	<4.2J	<25	<6.4J		<50		<50
Calcium	0.69	4		360-59,000	4,800-20,300	9,900	4,800	20,300		<200		<200
Chromium	0.066	1		<4.3-47	7.5-47	7.5	47	8.5		<50		<50
Cobalt	N/A	8.4-13		<5.1-12	<8.4-12	<8.4	12	<13		<100		<100
Copper	0.045	1		<2.7-45	11-45	11	45	24		<50		<50
Iron	0.50	2		5,400-35,000	10,800-31,000	10,800	31,000	14,600		<100		<100
Lead	0.13	8.4-13		<5.1-22	<8.4-22	<8.4	22	<13		<100		<100
Magnesium	0.96	4		360-7,400	1,300-7,300	1,300	7,300	3,200		<200		<200
Manganese	0.025	1		25-290	50-210	51	210	50		<50		<50
Molybdenum	N/A	4.2-25		<2.5-<11	<4.2-<25	<4.2	<25	<6.4		<50		<50
Nickel	0.11	1		4.2-46	24-46	24	46	30		<50		<50
Potassium	23	420-640		<300-2,200	<420-1,800	<420	1,800	<640		<5,000		<5,000

☐ CT&E Data.
N/A Not available.
J Result is an estimate.

TABLE G-2. BACKGROUND ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Background (BKGD)
Matrix: Soil/Sediment
Units: mg/kg
METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Point Lonely Bkgd. Range	Environmental Samples			Field Blank			Lab Blanks
						S01	SD01	SD02		EB02		
Laboratory Sample ID Numbers						4506-3	4504-6	4506-4		4506-1		4504 4506
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		µg/L		µg/L
Selenium	1.2	49-130		<7.8-<170	<49-<130	<84	<49	<130		<100		<100
Silver	0.53	25-64		<3-<110	<2.5-<64R	<42R	<25	<64R		<50J		<50
Sodium	0.55	5		<160-680	370-680	410	370	680		<250		<250
Thallium	0.011	0.20-0.68		<0.2-<1.2	<0.20-<0.68	<0.44	<0.20	<0.68		<5		<5
Vanadium	0.036	0.1		6.3-59	17-59	17	59	17		<50		<50
Zinc	0.16	1		9.2-95	9.4-95	20	95	9.4		<50		<50

☐ CT&E Data.
J Result is an estimate.
R Result has been rejected.

TABLE G-2. BACKGROUND ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Background (BKGD)

Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples: SW01 & SW03 (Duplicates)		Environmental Samples: SW02	Field Blanks: AB01	Field Blanks: EB02	Field Blanks: TB02	Lab Blanks
Laboratory Sample ID Numbers					706 707 4504-1	688 690 4504-5	666 672 4506-2	906	694 696 4506-1	684 4505-3	#5-82793 #3&4-82593 4504 4505 4506
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
DRPH	100	<1,000		<1,000[b]	<1,000[b]	<1,000[b]	<1,000[b]	NA	<1,000[b]	NA	<1,000
GRPH	10	100		<100J[b]	<100J[b]	<100J[b]	<100J[b]	<100J[b]	<100J[b]	<50[b]	<50
RRPH (Approx.)	200	2,000		<2,000	<2,000	<2,000	<2,000	NA	<2,000	NA	<2,000
BTEX (8020/8020 Mod.)											
Benzene	0.1	1	5	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	0.1	1	1,000	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	0.1	1	700	<1	<1	<1	<1	<1	<1	<1	<1
Xylenes (Total)	0.2	2	10,000	<2	<2	<2	<2	<2	<2	<2	<2
HVOC 8010	0.1	1		<1	<1	<1	<1	<1	<1	NA	<1
VOC 8260											
1,2-Dichloroethane	1	1	5	4.9-7.9	7.9	5.7	4.9	NA	<1	<1	<10
SVOC 8270	10	10.2-11		<10.2-<11	NA	<11	<10.2-<10.2J	NA	<10.2	NA	<10
PCBs	0.2	2	0.5	<2	<2	<2	<2	NA	<2	NA	<2
Pesticides	0.02-1	0.2-10		<0.2J-<10J	<0.2J-<10J	<0.2J-<10J	<0.2J-<10J	NA	<0.2J-<10J	NA	NA

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-2. BACKGROUND ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Background (BKGD)
Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples: SW01 & SW03 (Duplicates)		Environmental Samples: SW02	Field Blanks: AB01	Field Blanks: EB02	Field Blanks: TB02	Lab Blanks
Laboratory Sample ID Numbers					706 707 4504-1	688 690 4504-5	666 672 4506-2	906	694 696 4506-1	684 4505-3	4504 4505 4506
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
TOC	5,000	5,000		25,200-28,700	28,700	26,500	25,200	NA	<5,000	NA	<5,000
TSS	100	200		5,000-12,000	12,000	5,000	9,000	NA	NA	NA	<200
TDS	10,000	10,000		253,000-424,000	424,000	422,000	253,000	NA	NA	NA	<10,000

☐ CT&E Data.
NA Not analyzed.

TABLE G-2. BACKGROUND ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Background (BKGD)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL
(DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Point Lonely Bkgd. Range	Environmental Samples: SW01 & SW03 (Duplicates)		Environmental Samples: SW02	Field Blank: EB02	Lab Blanks
Laboratory Sample ID Numbers						4504-1	4504-5	4506-2	4506-1	4504 4506
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Aluminum	17.4	100		<100-350 (<100-340)	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)	<100	<100
Antimony	N/A	100	6	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)	<100	<100
Arsenic	5.3	100	50	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)	<100	<100
Barium	1.2	50	2,000	<50-93 (<50-91)	<50-65 (<50-60)	65 (60)	62 (60)	<50 (<50)	<50	<50
Beryllium	N/A	50	4	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)	<50	<50
Cadmium	1.7	50	5	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)	<50	<50
Calcium	34.5	200		4,500-88,000 (4,100-86,000)	19,000-35,000 (19,000-34,000)	35,000 (34,000)	34,000 (34,000)	19,000 (19,000)	<200	<200
Chromium	3.29	50	100	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)	<50	<50
Cobalt	N/A	100		<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)	<100	<100
Copper	2.3	50	1,300	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)	<50	<50
Iron	25	100		180-2,800 (<100-1,600)	470-610 (190-330)	610 (210)	580 (190)	470 (330)	<100	<100
Lead	6.6	100	15	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)	<100	<100

☐ CT&E Data.
N/A Not analyzed.

TABLE G-2. BACKGROUND ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Background (BKGD)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL
(DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Point Lonely Bkgd. Range	Environmental Samples: SW01 & SW03 (Duplicates)	Environmental Samples: SW01 & SW03 (Duplicates)	Environmental Samples: SW02	Field Blank: EB02	Lab Blanks
Laboratory Sample ID Numbers						4504-1	4504-5	4506-2	4506-1	4504 4506
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Magnesium	47.8	200		<5,000-53,000 (2,600-54,000)	11,000-22,000 (11,000-22,000)	22,000 (22,000)	22,000 (21,000)	11,000 (11,000)	<200	<200
Manganese	1.24	50		<50-510 (<50-120)	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)	<50	<50
Molybdenum	N/A	50		<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)	<50	<50
Nickel	5.5	50	100	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)	<50	<50
Potassium	1,154	5,000		<5,000 (<5,000)	<5,000 (<5,000)	<5,000 (<5,000)	<5,000 (<5,000)	<5,000 (<5,000)	<5,000	<5,000
Selenium	62.4	100	50	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)	<100 (<100)	<100	<100
Silver	2.6	50	50	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)	<50J (<50R)	<50J	<50J
Sodium	27.7	250		8,400-410,000 (8,200-450,000)	35,000-70,000 (35,000-70,000)	70,000 (70,000)	68,000 (68,000)	35,000 (35,000)	<250	<250
Thallium	0.57	5	2	<5 (<5)	<5 (<5)	<5 (<5)	<5 (<5)	<5 (<5)	<5	<5
Vanadium	1.8	50		<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)	<50	<50
Zinc	8.2	50		<50-160 (<50)	<50 (<50)	<50 (<50)	<50 (<50)	<50 (<50)	<50	<50

☐ CT&E Data.
N/A Not analyzed.

TABLE G-3. SEWAGE DISPOSAL AREA ANALYTICAL DATA SUMMARY

Installation: Point Lonely Matrix: Soil
Site: Sewage Disposal Area (SS01) Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples						Field Blanks			Lab Blanks	
					S01	S02-3 & S14-3 (Replicates)		S03	S04-3	S05	AB02	EB03	TB03		
Laboratory Sample ID Numbers					852	854	880	858	860 4425-1	862	1094	942/944 4425-9	916 4425-8	#5-82893 4425	#6-82893 4425
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5-7	50-70	500[a]	<190[b]-150J[b]	<50[b]	<50[b]	<50[b]	<50[b]	2,500J[b]	<70[b]	NA	<1,000[b]	NA	<1,000	<50
GRPH	0.2-10.9	2-109	100	<20J[b]-27J[b]	<20J[b]	<2J[b]	<2J[b]	<2J[b]	<109J[b]	<2J[b]	<50J[b]	<100J[b]	<100J[b]	NA	NA
RRPH (Approx.)	10-14	100-140	2,000[a]	<180-<870	<100	<100	<100	<100	<100	<140	NA	<2,000	NA	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<1-2.7J	<1.0J	<0.1	<0.1	<0.1	<1.0J	<0.1					
Benzene	0.002-0.02	0.02-0.2	0.5	<0.04-<0.3	<0.2J	<0.02	<0.02	<0.02	<0.2J	<0.02	<1	<1	<1	NA	NA
Ethylbenzene	0.002-0.02	0.02-0.2		<0.2-0.5	<0.2J	<0.02	<0.02	<0.02	<0.2J	<0.02	<1	<1	<1	NA	NA
Toluene	0.002-0.02	0.02-0.2		<0.2-0.2	<0.2J	<0.02	<0.02	<0.02	<0.2J	<0.02	<1	<1	<1	NA	NA
Xylenes (Total)	0.004-0.04	0.04-0.4		<0.4-2.0J	<0.4J	<0.04	<0.04	<0.04	<0.4J	<0.04	<2	<2	<2	NA	NA
VOC 8260															
sec-Butylbenzene	0.020	0.200		<0.300-0.136	NA	NA	NA	NA	0.287	NA	NA	<1	<1	<1	<0.020
p-Isopropyltoluene	0.020	0.200		<0.300-0.107	NA	NA	NA	NA	1.120	NA	NA	<1	<1	<1	<0.020
Naphthalene	0.020	0.200		<0.300-0.211	NA	NA	NA	NA	2.290	NA	NA	<1	<1	<1	<0.020
1,2,4-Trimethylbenzene	0.020	0.200		<0.300-0.956	NA	NA	NA	NA	5.730	NA	NA	<1	<1	<1	<0.020
1,3,5-Trimethylbenzene	0.020	0.200		<0.300-0.409	NA	NA	NA	NA	4.320	NA	NA	<1	<1	<1	<0.020
Xylenes (Total)	0.040	0.400		<0.600-2.267	NA	NA	NA	NA	1.591	NA	NA	<2	<2	<2	<0.040
SVOC 8270															
Naphthalene	0.200	0.230		<5.00-<30.0	NA	NA	NA	NA	0.485	NA	NA	<12	NA	<10	<0.200
2-Methylnaphthalene	0.200	0.230		<5.00-<30.0	NA	NA	NA	NA	1.63	NA	NA	<12	NA	<10	<0.200

□ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-3. SEWAGE DISPOSAL AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely Matrix: Soil
Site: Sewage Disposal Area (SS01) Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks	
					S06-3	S07-1	S08-2.5	S09	S10-4	AB02	EB03	TB03		
Laboratory Sample ID Numbers					864	866	868	870	872	1094	942 944	916	#5-82893	#6-82893
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5-8	50-80	500[a]	<190[b]-150J[b]	<80[b]	5,000J[b]	16,000J[b]	<50[b]	<50[b]	NA	<1,000[b]	NA	<1,000	<50
GRPH	0.2	2	100	<20J[b]-27J[b]	270J[b]	100J[b]	80J[b]	<2J[b]	<2J[b]	<50J[b]	<100J[b]	<100J[b]	NA	NA
RRPH (Approx.)	10-15	100-150	2,000[a]	<180-<670	<150	<110	<110	<100	<100	NA	<2,000	NA	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<1-2.7J	1.4J	<1.6	<1.4	<0.1	<0.1J					
Benzene	0.002-0.02	0.02-0.2	0.5	<0.04-<0.3	<0.02	<0.2	<0.2	<0.02	<0.02	<1	<1	<1	NA	NA
Ethylbenzene	0.002-0.04	0.02-0.4		<0.2-0.5	<0.4	<0.4	<0.2	<0.02	<0.02J	<1	<1	<1	NA	NA
Toluene	0.002-0.02	0.02-0.2		<0.2-0.2	1.4J	<0.2	<0.2	<0.02	<0.02	<1	<1	<1	NA	NA
Xylenes (Total)	0.004-0.08	0.04-0.8		<0.4-2.0J	<0.8	<0.8	<0.8	<0.04	<0.04J	<2	<2	<1	NA	NA

▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-3. SEWAGE DISPOSAL AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Sewage Disposal Area (SS01)
Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks			Lab Blanks	
					S11-2.5	S12-2.5	S13-1	S15-2	AB02	EB03	TB03		
Laboratory Sample ID Numbers					874	876	878	882 4425-4	1094	4425-9 942 944	4425-8 916	#5-82893 4425	#6-82893 4425
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5-8	50-80	500[a]	<190[b]-150J[b]	3,000J[b]	2,300J[b]	1,500J[b]	6,300J[b]	NA	<1,000[b]	NA	<1,000	<50
GRPH	0.2-0.4	2-4	100	<20J[b]-27J[b]	80J[b]	1,000J[b]	580J[b]	<4[b]	<50J[b]	<100J[b]	<100J[b]	NA	NA
RRPH (Approx.)	10-17	100-170	2,000[a]	<180-<670	<100	<100	<140	<170	NA	<2,000	NA	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<1-2.7J	10.7J	49J	<0.1	<0.20					
Benzene	0.002-0.004	0.02-0.04	0.5	<0.04-<0.3	<0.02	<0.02	<0.02	<0.04	<1	<1	<1	NA	NA
Ethylbenzene	0.002-0.004	0.02-0.04		<0.2-0.5	0.7J	7J	<0.02	<0.04	<1	<1	<1	NA	NA
Toluene	0.002-0.004	0.02-0.04		<0.2-0.2	<0.2	10J	<0.02	<0.04	<1	<1	<1	NA	NA
Xylenes (Total)	0.004-0.008	0.04-0.08		<0.4-2.0J	10J	32J	<0.04	<0.08	<2	<2	<2	NA	NA
VOC 8260													
n-Butylbenzene	0.020	0.400		<0.300-0.218	NA	NA	NA	3.51J	NA	<1	<1	<1	<0.020
sec-Butylbenzene	0.020	0.400		<0.300-0.136	NA	NA	NA	0.49J	NA	<1	<1	<1	<0.020
p-Isopropyltoluene	0.020	0.400		<0.300-0.107	NA	NA	NA	0.931J	NA	<1	<1	<1	<0.020
Naphthalene	0.020	0.400		<0.300-0.211	NA	NA	NA	6.80J	NA	<1	<1	<1	<0.020
1,2,4-Trimethylbenzene	0.020	0.400		<0.300-0.956	NA	NA	NA	7.82J	NA	<1	<1	<1	<0.020
1,3,5-Trimethylbenzene	0.020	0.400		<0.300-0.409	NA	NA	NA	6.89J	NA	<1	<1	<1	<0.020

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-3. SEWAGE DISPOSAL AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Sewage Disposal Area (SS01)
Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks			Lab Blanks	
					S11-2.5	S12-2.5	S13-1	S15-2	AB02	EB03	TB03		
Laboratory Sample ID Numbers					874	876	878	882 4425-4	1094	4425-9 942 944	4425-8 916	4425	4425
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
Xylenes (Total)	0.040	0.800		<0.600-2.267	NA	NA	NA	4.57J	NA	<2	<2	<2	<0.040
SVOC 8270													
Naphthalene	0.200	3.20		<5.00-<30.0	NA	NA	NA	3.45	NA	<12	NA	<10	<0.200
2-Methylnaphthalene	0.200	3.20		<5.00-<30.0	NA	NA	NA	6.82	NA	<12	NA	<10	<0.200

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.

TABLE G-3. SEWAGE DISPOSAL AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely   Matrix: Soil/Sediment
Site: Sewage Disposal Area (SS01)   Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples: SD01 & SD04 (Replicates)		Environmental Samples: SD02	Environmental Samples: SD03	Environmental Samples: 2S21-1.5	Field Blanks: AB02	Field Blanks: EB03	Field Blanks: EB05	Field Blanks: TB03	Lab Blanks	
Laboratory Sample ID Numbers					884 4425-2	890 4425-3	886	888	1786	1094	942 944 4425-9	1796 1798 4626-6	916 4425-8	#5-82893 4425 4626	#6-82893 #3&4-83193 #1&2-83193 4425
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	8-28	80-280	500[a]	<190[b]-150J[b]	120J[b]	270J[b]	180J[b]	<280[b]	<80[b]	NA	<1,000[b]	<200[c]	NA	<1,000	<50
GRPH	0.2	2	100	<20J[b]-27J[b]	100J[b]	<2[b]	180[b]	<2J[b]	<2J[b]	<50J[b]	<100J[b]	<20[c]	<100J[b]	NA	<2
RRPH (Approx.)	12-14	120-140	2,000[a]	<180-<670	<120	<120	<120	<120	<140	NA	<2,000	<2,000	NA	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<1-2.7J	<2.0	<2.0	<2.0	<2.0	<0.21						
Benzene	0.003-0.04	0.03-0.4	0.5	<0.04-<0.3	<0.4	<0.4	<0.4	<0.4	<0.03	<1	<1	<1	<1	NA	<0.02
Ethylbenzene	0.005-0.04	0.05-0.4		<0.2-0.5	<0.4	<0.4	<0.4	<0.4	<0.06	<1	<1	<1	<1	NA	<0.02
Toluene	0.003-0.04	0.03-0.4		<0.2-0.2	<0.4	<0.4	<0.4	<0.4	<0.03	<1	<1	<1	<1	NA	<0.02
Xylenes (Total)	0.01-0.08	0.1-0.8		<0.4-2.0J	<0.8	<0.8	<0.8	<0.8	<0.10	<2	<2	<2	<2	NA	<0.04
VOC 8260															
n-Butylbenzene	0.020	0.030-0.350		<0.300-0.218	<0.350	0.372	NA	NA	NA	NA	<1	<1	<1	<1	<0.020
p-Isopropyltoluene	0.020	0.030-0.350		<0.300-0.107	<0.350	0.037	NA	NA	NA	NA	<1	<1	<1	<1	<0.020
Naphthalene	0.020	0.030-0.350		<0.300-0.211	<0.350	0.187	NA	NA	NA	NA	<1	<1	<1	<1	<0.020
1,2,4-Trimethylbenzene	0.020	0.030-0.350		<0.300-0.956	<0.350	0.313	NA	NA	NA	NA	<1	<1	<1	<1	<0.020
1,3,5-Trimethylbenzene	0.020	0.030-0.350		<0.300-0.409	0.779	0.774	NA	NA	NA	NA	<1	<1	<1	<1	<0.020
Xylenes (Total)	0.040	0.060-0.700		<0.300-2.267	<0.700	0.152	NA	NA	NA	NA	<2	<2	<2	<2	<0.040
SVOC 8270	0.200	2.50-2.90		<5.00-<30.0	<2.90	<2.50	NA	NA	NA	NA	<12	<12	NA	<10-<25	<0.200-<0.500

□ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and GRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c This sample was analyzed by F&B also; DRPH and GRPH were detected at <1,000[b] and <50[b] µg/L, respectively.

TABLE G-3. SEWAGE DISPOSAL AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Sewage Disposal Area (SS01)
Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blank	Lab Blanks	
					2S16-1	2S17-1	2S18-1	2S19-1	2S20-2	EB05		
Laboratory Sample ID Numbers					1780	1781	1782	1783	1784	1796 1798	#5-82893	#6-9993
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	mg/kg
DRPH	6-7	60-70	500[a]	<190[b]-150J[b]	<60[b]	<70[b]	<60[b]	6,600J[b]	<60[b]	<200[c]	<1,000	NA
RRPH (Approx.)	12-14	120-140	2,000[a]	<180-<670	<120	<140	<120	<140	<120	<2,000	<2,000	NA

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH concentrations reported for these samples are equivalent to diesel range organics (DRO) as defined by ADEC.
c This sample was analyzed by F&B also; DRPH were detected at <1,000[b] µg/L.

TABLE G-3. SEWAGE DISPOSAL AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Sewage Disposal Area (SS01)
Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples						Field Blanks			Lab Blanks
					SW01 & (Duplicates)	SW06	SW02	SW03	SW04	SW05	AB02	EB03	TB03	
Laboratory Sample ID Numbers					4430-1 917 918	4430-3 937 940	921 922	925 928	4430-2 929 932	933	1094	4425-9 942 944	4425-8 916	#5-82893 4430 4425
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
DRPH	100	1,000		<1,000[b]	<1,000[b]	<1,000[b]	<1,000[b]	<1,000[b]	<1,000[b]	<1,000[b]	NA	<1,000[b]	NA	<1,000
GRPH	10	100		<100J[b]	<100J[b]	<100J[b]	<100J[b]	<100J[b]	<100J[b]	NA	<50J[b]	<100J[b]	<100J[b]	NA
RRPH (Approx.)	200	2,000		<2,000	<2,000	<2,000	<2,000	<2,000	<2,000	<2,000	NA	<2,000	NA	<2,000
BTEX (8020/8020 Mod.)														
Benzene	0.1	1	5	<1	2	1	<1	<1	1	NA	<1	<1	<1	NA
Toluene	0.1	1	1,000	<1	<1	1	<1	<1	1	NA	<1	<1	<1	NA
Ethylbenzene	0.1	1	700	<1	<1	1J	<1	<1	<1	NA	<1	<1	<1	NA
Xylenes (Total)	0.2	2	10,000	<2	<2	2J	<2	<2	<2	NA	<2	<2	<2	NA
VOC 8260														
Chloromethane	1	1		<1	6.6	<1	NA	NA	<1	NA	NA	<1	<1	<1
1,2-Dichloroethane	1	1	5	4.9-7.9	7.7B	2.3B	NA	NA	3.4B	NA	NA	1.3	<1	<1
Naphthalene	1	1		<1	<1	1.1	NA	NA	<1	NA	NA	<1	<1	<1
1,3,5-Trimethyl-benzene	1	1		<1	<1	1.4	NA	NA	<1	NA	NA	<1	<1	<1
Xylenes (Total)	2	2	10,000	<2	<2	2.2	NA	NA	<2	NA	NA	<2	<2	<2

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
B The analyte was detected in the associated blank.
J Result is an estimate.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-3. SEWAGE DISPOSAL AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely Matrix: Surface Water
Site: Sewage Disposal Area (SS01) Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples						Field Blanks			Lab Blanks
					SW01 & (Duplicates)	SW06	SW02	SW03	SW04	SW05	AB02	EB03	TB03	
Laboratory Sample ID Numbers					4430-1 917 918	4430-3 937 940	921 922	925 928	4430-2 929 932	933	1094	4425-9 942 944	4425-8 916	4430 4425
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
SVOC 8270	10	10		<10.2-<11	<10	<10	NA	NA	<10	NA	NA	<12	NA	<10-<25
TOC	5,000	5,000		25,200-28,700	64,500	69,200	NA	NA	49,600	NA	NA	<5,000	NA	<5,000
TSS	100	100		5,000-12,000	28,000	32,000	NA	NA	19,000	NA	NA	NA	NA	<100
TDS	10,000	10,000		253,000-424,000	1,050,000	1,090,000	NA	NA	1,030,000	NA	NA	NA	NA	<10,000

☐ CT&E Data.
NA Not analyzed.

TABLE G-4. DRUM STORAGE AREA ANALYTICAL DATA SUMMARY

Installation: Point Lonely
Site: Drum Storage Area (ST02)
Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks					Lab Blanks	
					S01-3	S02	S03	S04	AB02	EB03	EB04	TB03	TB04		
Laboratory Sample ID Numbers					964	962 4425-6	1032	1036	1094	942/944 4425-9	1098 1100 4426-4	916 4425-8	1092 4426-3	#5-83093 #5-82893 #1&2-82893 4425	#6-82993 #6-82893 #3&4-83193 #1&2-82893 4425
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	6-22	60-220	500[a]	<190[b]-150J[b]	1,000J[b]	<60[b]	<220[b]	<140[b]	NA	<1,000[b]	<1,000J[b]	NA	NA	<1,000	<50
GRPH	0.2-0.6	2-6	100	<20J[b]-27J[b]	72J[b]	<2J[b]	90J[b]	<6J[b]	<50J[b]	<100J[b]	<50J[b]	<100J[b]	<50J[b]	NA	<2
RRPH (Approx.)	12-43	120-430	2,000[a]	<180-<670	1,300	<120	<430	<280	NA	<2,000	<2,000	NA	NA	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<1-2.7J	7.28J	<0.10	<4.0	<0.29							
Benzene	0.002-0.08	0.02-0.8	0.5	<0.04-<0.3	<0.03	<0.02	<0.8	<0.06	<1	<1	<2J	<1	<6J	<1	<0.02
Toluene	0.002-0.08	0.02-0.8		<0.2-0.5	0.08J	<0.02	<0.8	<0.06	<1	<1	<2J	<1	<4J	<1	<0.02
Ethylbenzene	0.002-0.08	0.02-0.8		<0.2-0.2	0.8J	<0.02	<0.8	<0.06	<1	<1	<2J	<1	<3J	<1	<0.02
Xylenes (Total)	0.004-0.16	0.04-1.6		<0.4-2.0J	6.3J	<0.04	<1.6	<0.11	<2	<2	<2J	<2	<3J	<2	<0.04
HVOC 8010	0.002-0.008	0.02-0.08		<0.04-<0.3	<0.02-<0.03	<0.02	<0.08	<0.06	<1	<1	<1	<1	<1	NA	<0.02
VOC 8260	0.020	0.020		<0.300-<0.500	NA	<0.020J	NA	NA	NA	<1-1.3	<1	<1	<1	<1	<0.020
SVOC 8270	0.200	0.220-1.01		<5.00-<30.0	NA	<0.220-1.01U	NA	NA	<0.500	<12	<26	NA	NA	<10-<25	<0.200-<0.500
PCBs	0.01-0.04	0.1-0.4	10	<0.1-<0.7	<0.1	<0.1	<0.4	<0.3	NA	<2	<2	NA	NA	<2	<0.1

□ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
U Compound is not present above the concentration listed.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-4. DRUM STORAGE AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Drum Storage Area (ST02)
Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks			Lab Blanks	
					S05	S06-2	S07	S08	AB02	EB04	TB04		
Laboratory Sample ID Numbers					1038	1040	1042	1044	1094	1098 1100	1092	#5-83093 #1&2-82893	#6-82993 #3&4-83193 #1&2-82893
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5-16	50-160	500[a]	<190[b]-150J[b]	<50[b]	<50[b]	<160J[b]	130J[b]	NA	<1,000J[b]	NA	<1,000	<50
GRPH	0.2-0.4	2-4	100	<20J[b]-27J[b]	<2J[b]	<2J[b]	<4J[b]	8J[b]	<50J[b]	<50J[b]	<50J[b]	NA	<2
RRPH (Approx.)	10-19	100-190	2,000[a]	<180-670[b]	<110	<100	<190	<130	NA	<2,000	NA	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<1-2.7J	<0.10	<0.10	0.1J	1.23J					
Benzene	0.002-0.004	0.02-0.04	0.5	<0.04-<0.3	<0.02	<0.02	0.1J	0.05J	<1	<2J	<6J	<1	<0.02
Toluene	0.002-0.004	0.02-0.04		<0.2-0.5	<0.02	<0.02	<0.04	0.4J	<1	<2J	<4J	<1	<0.02
Ethylbenzene	0.002-0.004	0.02-0.04		<0.2-0.2	<0.02	<0.02	<0.04	0.08J	<1	<2J	<3J	<1	<0.02
Xylenes (Total)	0.004-0.008	0.04-0.08		<0.4-2.0J	<0.04	<0.04	<0.08	0.7J	<2	<2J	<3J	<2	<0.04
HVOC 8010													
Tetrachloroethene	0.002-0.004	0.02-0.04		<0.04-<0.3	<0.02	<0.02	<0.04	2J	<1	<1	<1	NA	<0.02
PCBs	0.01-0.02	0.1-0.2	10	<0.1-<0.7	<0.1	<0.1	<0.2	<0.1	NA	<2	NA	NA	<0.1

■ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-4. DRUM STORAGE AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Drum Storage Area (ST02)
Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blank	Lab Blanks	
					2S09-1.5	2S10-1	2S11-1	EB05		
Laboratory Sample ID Numbers					1800	1802	1804	1796/1798 4626-6	#6-9993 #1&2-9793 4626	#1&2-9793
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	mg/kg
DRPH	7-27	70-270	500[a]	<190[b]-150J[b]	<270[b]	<70[b]	<70[b]	<200[c]	<200	NA
GRPH	0.2	2	100	<20J[b]-27J[b]	6J[b]	<2J[b]	15[b]	<20[c]	<20	<1
RRPH (Approx.)	20-53	200-530	2,000[a]	<180-<670	<530	<200	<200	<2,000	<2,000	NA
BTEX (8020/8020 Mod.)			10 Total BTEX	<1-2.7J	<0.7	<0.21	<1.11			
Benzene	0.003-0.01	0.03-0.1	0.5	<0.04-<0.3	<0.1	<0.03	<0.03	<1	<1	<0.02
Toluene	0.003-0.01	0.03-0.1		<0.2-0.5	<0.1	<0.03	<0.03	<1	<1	<0.02
Ethylbenzene	0.005-0.02	0.05-0.2		<0.2-0.2	<0.2	<0.05	<0.05	<1	<1	<0.02-<0.03
Xylenes (Total)	0.01-0.1	0.1-1		<0.4-2.0J	<0.3	<0.1	<1J	<2	<2	<0.04-<0.09
HVOC 8010	0.03-0.1	0.3-1		<0.04-<0.3	<1	<0.3	<0.3	<1	<1-<10	<0.04-<0.2

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c This sample was analyzed by F&B also; DRPH and GRPH were detected at <1,000[b] and <50[b] µg/L, respectively.

TABLE G-4. DRUM STORAGE AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Drum Storage Area (ST02)

Matrix: Soil
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample					Field Blank	Lab Blank
					S02					EB03	
Laboratory Sample ID Numbers					4425-6					4425-9	4425
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					µg/L	µg/L
Aluminum	0.35	2		1,500-25,000	3,000					<100	<100
Antimony	N/A	54		<7.8-<230	<54					<100	<100
Arsenic	0.11	54		<4.9-8.5	<54					<100	<100
Barium	0.024	1		27-390	92					<50	<50
Beryllium	N/A	2.7		<2.6-6.4	<2.7					<50	<50
Cadmium	0.33	2.7		<3.0-<36	<2.7					<50	<50
Calcium	0.69	4		360-59,000	38,000J					250	<200
Chromium	0.066	1		<4.3-47	3					<50	<50
Cobalt	N/A	5.4		<5.1-12	<5.4					<100	<100
Copper	0.45	27		<2.7-45	<27					<50	<50
Iron	0.50	2		5,400-35,000	10,000					<100	<100
Lead	0.13	54		<5.1-22	<54					<100	<100
Magnesium	0.96	4		360-7,400	22,000J					<200	<200
Manganese	0.025	1		25-290	110					<50	<50
Molybdenum	N/A	2.7		<2.5-<11	<2.7					<50	<50
Nickel	0.11	1		4.2-46	5.1					<50	<50
Potassium	23	100		<300-2,200	460					<5,000	<5,000

☐ CT&E Data.
N/A Not available.
J Result is an estimate.

TABLE G-4. DRUM STORAGE AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Drum Storage Area (ST02)
Matrix: Soil
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample					Field Blank	Lab Blank
					S02					EB03	
Laboratory Sample ID Numbers					4425-6					4425-9	4425
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					µg/L	µg/L
Selenium	1.2	54		<7.8-<170	<54					<100	<100
Silver	0.53	1		<3-<110	<27R					<50	<50
Sodium	0.55	5		<160-680	280					420J	<250
Thallium	0.011	0.57		<0.2-<1.2	<0.27					<5	<5
Vanadium	0.036	1		6.3-59	22					<50	<50
Zinc	0.16	1		9.2-95	13					<50	<50

☐ CT&E Data.
J Result is an estimate.
R Result has been rejected.

TABLE G-4. DRUM STORAGE AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Drum Storage Area (ST02)

Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples						Field Blanks					Lab Blanks
					SW01	SW02 & SW05 (Duplicates)		SW03	SW04	SW06	AB02	EB03	EB04	TB03	TB04	
Laboratory Sample ID Numbers					972 978 4423-1	1062 1064	1077 1078 1080	1068 1070	1072 1074	1082 1084	1094	942 944 4425-9	1098 1100	916 4425-8	1092	#5-83093 #5-82893 4423
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
DRPH	100	1,000		<1,000[b]	<1,000[b]	<1,000J[b]	<1,000[b]	<1,000J[b]	<1,000J[b]	<1,000J[b]	NA	<1,000[b]	<1,000J[b]	NA	NA	<1,000
GRPH	5-10	50-100		<100J[b]	<100J[b]	<50J[b]	<50J[b]	<50J[b]	<50J[b]	<50J[b]	<50J[b]	<100[b]	<50J[b]	<100J[b]	<50J[b]	NA
RRPH (Approx.)	200	2,000		<2,000	<2,000	<2,000	<2,000	<2,000	<2,000	<2,000	NA	<2,000	<2,000	NA	NA	<2,000
BTEX (8020/8020 Mod.)																
Benzene	0.1	1	5	<1	<1	<1	<1	<1	<1	500J	<1	<1	<2J	<1	<6J	NA
Toluene	0.1	1	1,000	<1	<1	<1	<1	<1	<1	1,500J[c]	<1	<1	<2J	<1	<4J	NA
Ethylbenzene	0.1	1	700	<1	<1	<1	<1	<1	<1	38	<1	<1	<2J	<1	<3J	NA
Xylenes (Total)	0.2	2	10,000	<2	<2	<2	<2	<2	<2	1,500J[c]	<2	<2	<2J	<2	<3J	NA
HVOC 8010	0.1	1		<1	<1	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	NA
VOC 8260																
1,2-Dichloroethane	1	1	5	4.9-7.9	1.9B	NA	NA	NA	NA	NA	NA	1.3	<1	<1	<1	<1
SVOC 8270	10	30		<10.2-<11	<30	NA	NA	NA	NA	NA	NA	<12	<26	NA	NA	<10-<25
PCBs	0.2	2	0.5	<2	<2	<2J	<2	<2J	<2J	<2J	NA	<2	<2	NA	NA	<5
TOC	5,000	5,000		25,200-28,700	29,700	NA	NA	NA	NA	NA	NA	<5,000	<5,000	NA	NA	<5,000
TSS	100	100		5,000-12,000	8,500	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<100
TDS	10,000	10,000		253,000-424,000	858,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<10,000

□ CT&E Data.
▩ F&B Data.
NA Not analyzed.
B The analyte was detected in the associated blank.
J Result is an estimate.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c Results outside calibration range.

TABLE G-4. DRUM STORAGE AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Drum Storage Area (ST02)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL
(DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample					Field Blank	Lab Blanks
					SW01					EB03	
Laboratory Sample ID Numbers					4423-1					4425-9	4425 4423
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L					µg/L	µg/L
Aluminum	17.4	100		<100-350 (100-340)	<100 (<100)					<100	<100
Antimony	N/A	100	6	<100 (<100)	<100 (<100)					<100	<100
Arsenic	5.3	100	50	<100 (<100)	<100 (<100)					<100	<100
Barium	1.2	50	2,000	<50-93 (50-91)	160 (160)					<50	<50
Beryllium	N/A	50	4	<50 (<50)	<50 (<50)					<50	<50
Cadmium	1.7	50	5	<50 (<50)	<50 (<50)					<50	<50
Calcium	34.5	200		4,500-88,000 (4,100-86,000)	57,000 (56,000)					250	<200
Chromium	3.29	50	100	<50 (<50)	<50 (<50)					<50	<50
Cobalt	N/A	100		<100 (<100)	<100 (<100)					<100	<100
Copper	2.3	50	1,300	<50 (<50)	<50 (<50)					<50	<50
Iron	25	100		180-2,800 (<100-1,600)	380 (180)					<100	<100

☐ CT&E Data.
N/A Not available

TABLE G-4. DRUM STORAGE AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Drum Storage Area (ST02)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL
(DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample					Field Blank	Lab Blanks
					SW01					EB03	
Laboratory Sample ID Numbers					4423-1					4425-9	4425 4423
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L					µg/L	µg/L
Lead	6.6	100	15	<100 (<100)	<100 (<100)					<100	<100
Magnesium	47.8	200		<5,000-53,000 (2,600-54,000)	48,000 (50,000J)					<200	<200
Manganese	1.24	50		<50-510 (<50-120)	55 (<50)					<50	<50
Molybdenum	N/A	50		<50 (<50)	<50 (<50)					<50	<50
Nickel	5.5	50	100	<50 (<50)	<50 (<50)					<50	<50
Potassium	1,154	5,000		<5,000 (<5,000)	<5,000 (<5,000)					<5,000	<5,000
Selenium	62.4	100	50	<100 (<100)	<100 (<100)					<100	<100
Silver	2.6	50	50	<50 (<50)	<50 (<50)					<50	<50
Sodium	27.7	250		8,400-410,000 (8,200-450,000)	110,000J (130,000)					420	<250
Thallium	0.57	5	2	<5 (<5)	<5 (<5)					<5	<5
Vanadium	1.8	50		<50 (<50)	<50 (<50)					<50	<50
Zinc	8.2	50		<50-160 (<50)	<50 (<50)					<50	1,631

☐ CT&E Data.
N/A Not available

TABLE G-5. BEACH DIESEL TANKS ANALYTICAL DATA SUMMARY

Installation: Point Lonely   Matrix: Soil
Site: Beach Diesel Tanks (SS03)   Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks	
					S01	S02-2.5	S03	S04-0.75 & S05-0.75 (Replicates)		AB01	EB01	TB01		
Laboratory Sample ID Numbers					536 4357-4	538	540	542	544	906	530/534 4357-1	528 4357-8	#5-82793 #3&4-82593 4357	#5-82593 #1&2-82593 4357
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5-12	50-120	500[a]	<190[b]-150J[b]	<50[b]	<60[b]	<120[b]	<100[b]	<60[b]	NA	<1,000[b]	NA	<1,000	<50
GRPH	0.2-0.5	2-5	100	<20J[b]-27J[b]	<2J[b]	<2J[b]	<4J[b]	<5J[b]	<2J[b]	<100J[b]	<100J[b]	<100J[b]	<50	<1
RRPH (Approx.)	10-20	100-200	2,000[a]	<180-<670	<100	<120	<200	<200	<120	NA	<2,000	NA	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<1-2.7J	<0.10	<0.10	<0.20	<0.25	<0.10					
Benzene	0.002-0.005	0.02-0.05	0.5	<0.04-<0.3	<0.02	<0.02	<0.04	<0.05	<0.02	<1	<1	<1	<1	<0.02
Toluene	0.002-0.005	0.02-0.05		<0.2-0.5	<0.02	<0.02	<0.04	<0.05	<0.02	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002-0.005	0.02-0.05		<0.2-0.2	<0.02	<0.02	<0.04	<0.05	<0.02	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004-0.010	0.04-0.10		<0.4-2.0J	<0.04	<0.04	<0.08	<0.10	<0.04	<2	<2	<2	<2	<0.04
VOC 8260														
Naphthalene	0.020	<0.020		<0.300-0.211	0.039	NA	NA	NA	NA	NA	<1	<1	<1	<0.020
Toluene	0.020	<0.020		<0.300-<0.500	0.033	NA	NA	NA	NA	NA	<1	<1	<1	<0.020
1,2,4-Trimethylbenzene	0.020	<0.020		<0.300-0.956	0.174	NA	NA	NA	NA	NA	<1	<1	<1	<0.020
1,3,5-Trimethylbenzene	0.020	<0.020		<0.300-0.409	0.071	NA	NA	NA	NA	NA	<1	<1	<1	<0.020
Xylenes (Total)	0.040	<0.040		<0.600-2.267	0.116	NA	NA	NA	NA	NA	<2	<2	<2	<0.040
SVOC 8270	0.200	0.210-0.552		<5.00-<30.0	<0.210-0.552U	NA	NA	NA	NA	NA	<29	NA	<10	0.459

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
U Compound is not present above the concentration listed.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-5. BEACH DIESEL TANKS ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely Site: Beach Diesel Tanks (SS03)			Matrix: Soil/Sediment Units: mg/kg											
Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks				Lab Blanks	
					2S06 & 2S07 (Replicates)		SD01	SD02	AB01	EB01	EB05	TB01		
Laboratory Sample ID Numbers					1806	1808	546	548	906	530 534	1796 1798 4626-6	528	#5-82793 #3&4-82593 4626	#5-82593 #1&2-9793 #1&2-82593
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	6-10	60-100	500[a]	<190[b]-150J[b]	15,200J[b]	13,700J[b]	<60[b]	<60[b]	NA	<1,000[b]	<200[c]	NA	<200-<1,000	<50
GRPH	0.2-0.3	2-3	100	<20J[b]-27J[b]	150[b]	13J[b]	<2J[b]	<2J[b]	<100J[b]	<100J[b]	<20[c]	<100J[b]	<20-<50	<1
RRPH (Approx.)	12-20	120-200	2,000[a]	<180-<670	<200	<200	<200	<120	NA	<2,000	<2,000	NA	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<1-2.7J	1.8	0.8J	<0.10	<0.10						
Benzene	0.002	0.02	0.5	<0.04-<0.3	<0.02	<0.02	<0.02	<0.02	<1	<1	<1	<1	<1	<0.02
Toluene	0.002	0.02		<0.2-0.5	<0.02	<0.02	<0.02	<0.02	<1	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002	0.02		<0.2-0.2	0.3	0.2	<0.02	<0.02	<1	<1	<1	<1	<1	<0.02-<0.03
Xylenes (Total)	0.004	0.04		<0.4-2.0J	1.5	0.6J	<0.04	<0.04	<2	<2	<2	<2	<2	<0.04-<0.09
HVOC 8010	0.01	0.1		<0.04-<0.3	<0.1	<0.1	NA	NA	<1	<1	<1	<1	<1	<0.02-<0.2

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
U Compound is not present above the concentration listed.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c This sample was analyzed by F&B also; DRPH and GRPH were detected at <1,000[b] and <50[b] µg/L, respectively.

TABLE G-5. BEACH DIESEL TANKS ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Beach Diesel Tanks (SS03)
Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks
					SW01	SW02				AB01	EB01	TB01	
Laboratory Sample ID Numbers					549 552 4357-7	550 554				906	530 534 4357-1	528 4357-8	#5-82793 #3&4-82593
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L				µg/L	µg/L	µg/L	µg/L
DRPH	100	1,000		<1,000[b]	<1,000[b]	<1,000[b]				NA	<1,000[b]	NA	<1,000
GRPH	5-10	50-100		<100J[b]	<50[b]	<100J[b]				<100J[b]	<100J[b]	<100J[b]	<50
RRPH (Approx.)	200	2,000		<2,000	<2,000	<2,000				NA	<2,000	NA	<2,000
BTEX (8020/8020 Mod.)													
Benzene	0.1	1	5	<1	<1	<1				<1	<1	<1	<1
Toluene	0.1	1	1,000	<1	<1	<1				<1	<1	<1	<1
Ethylbenzene	0.1	1	700	<1	<1	<1				<1	<1	<1	<1
Xylenes (Total)	0.2	2	10,000	<2	<2	<2				<2	<2	<2	<2
VOC 8260	1	1-2.9		<1-7.9	<1-2.9U	NA				NA	<1-1.3	<1	<1
SVOC 8270	10	13		<10	<13-<13J	NA				NA	<29	NA	<10
TOC	5,000	5,000		25,200-28,700	43,600	NA				NA	<5,000	NA	<5,000
TSS	100	200		5,000-12,000	18,000	NA				NA	NA	NA	<200
TDS	10,000	10,000		253,000-424,000	1,430,000	NA				NA	NA	NA	<10,000

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
U Compound is not present above the concentration listed.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-6. POL STORAGE ANALYTICAL DATA SUMMARY

Installation: Point Lonely Site: POL Storage (SS04)   Matrix: Soil/Sediment Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks				Lab Blanks	
					S01	S02-2.5	SD01	SD02	2SD03	AB01	EB01	EB05	TB01		
Laboratory Sample ID Numbers					518 4355-8	524	520	522	1795	906	530 534	1796 1798 4626-6	528 4357-8	#5-82793 #3&4-82593 4626	#5-82593 #1&2-82593 4355
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5-12	50-120	500[a]	<190[b]-150J[b]	<2,000[b]	<50[b]	<60[b]	<60[b]	<120[b]	NA	<1,000[b]	<200[c]	NA	<1,000	<50
GRPH	0.2	2	100	<20[b]-27[b]	<2J[b]	<2J[b]	64J[b]	<2J[b]	NA	<100J[b]	<50J[b]	<20[c]	<100J[b]	<50	<1
RRPH (Approx.)	10-24	100-240	2,000[a]	<180-<670	<100	<120	<120	<120	<240	NA	<2,000	<2,000	NA	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<1.0-2.7J	<0.10	<0.10	7.5J	<0.10	NA						
Benzene	0.002	0.02	0.5	<0.04-<0.3	<0.02	<0.02	1.6	<0.02	NA	<1	<1	<1	<1	<1	<0.02
Toluene	0.002	0.02		<0.2-0.5	<0.02	<0.02	1.4	<0.02	NA	<1	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002	0.02		<0.2-0.2	<0.02	<0.02	2.0	<0.02	NA	<1	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004	0.04		<0.4-2.0J	<0.04	<0.04	2.5J	<0.04	NA	<2	<2	<2	<2	<2	<0.04
HVOC 8010															
Trichloroethene	0.002	0.02		<0.04-<0.3	<0.02	<0.02	24	<0.02	NA	<1	<1	<1	<1	<1	<0.02
Tetrachloroethene	0.002	0.02		<0.04-<0.3	0.36	<0.02	6.7J	<0.02	NA	<1	<1	<1	<1	<1	<0.02
VOC 8260	0.020	0.100		<0.300-2.267	<0.100	NA	NA	NA	NA	NA	<1	<1	<1	<1	<0.020
TOC				99,600-473,000	8,510	NA	NA	NA	NA	NA	<5,000	NA	NA	NA	NA

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c This sample was analyzed by F&B also; DRPH and GRPH concentrations were detected at <1,000[b] and <50[b] µg/L, respectively.

TABLE G-6. POL STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: POL Storage (SS04)

Matrix: Soil
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample					Field Blank	Lab Blanks
					S01					EB01	
Laboratory Sample ID Numbers					4355-6					4357-1	4355 4357
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					µg/L	µg/L
Aluminum	0.35	2		1,500-25,000	2,400					<100	<100
Antimony	N/A	51		<7.8-<230	<51					<100	<100
Arsenic	0.11	51		<4.9-8.5	<51					<100	<100
Barium	0.024	1		27-390	72					<50	<50
Beryllium	N/A	2.6		<2.6-6.4	<2.6					<50	<50
Cadmium	0.33	2.6		<3.0-<36	<2.6					<50	<50
Calcium	0.69	4		360-59,000	45,000					270	<200
Chromium	0.066	1		<4.3-47	3.4					<50	<50
Cobalt	N/A	5.1		<5.1-12	<5.1					<100	<100
Copper	0.045	1		<2.7-45	3.2					<50	<50
Iron	0.50	2		5,400-35,000	11,000					<100	<100
Lead	0.13	5.1		<5.1-22	<5.1					<100	<100
Magnesium	0.96	4		360-7,400	25,000					<200	<200
Manganese	0.025	1		25-290	130					<50	<50
Molybdenum	N/A	2.6		<2.5-<11	<2.6					<50	<50
Nickel	0.11	1		4.2-46	5.1					<50	<50
Potassium	23	100		<300-2,200	420					<5,000	<5,000
Selenium	1.2	51		<7.8-<170	<51					<100	<100

☐ CT&E Data.
N/A Not available

TABLE G-6. POL STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: POL Storage (SS04)

Matrix: Soil
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample					Field Blank	Lab Blanks
					S01					EB01	
Laboratory Sample ID Numbers					4355-6					4357-1	4355 4357
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					µg/L	µg/L
Silver	0.53	26		<3-<110	<26					<50J	<50
Sodium	0.55	5		<160-680	140					370J	<250
Thallium	0.011	0.26		<0.2-<1.2	<0.26					<5	<5
Vanadium	0.036	1		6.3-59	10					<50	<50
Zinc	0.16	1		9.2-95	12					<50	<50

☐ CT&E Data.
N/A Not available

TABLE G-6. POL STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely Site: POL Storage (SS04)		Matrix: Surface Water Units: µg/L										
Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Sample				Field Blanks			Lab Blanks
					SW01				AB01	EB01	TB01	
Laboratory Sample ID Numbers					512 514 4355-3				906	530 534 4357-1	528 4357-8	#3&4-82593 4355
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L				µg/L	µg/L	µg/L	µg/L
GRPH	5	50		<1,000[b]	3,000J[b]				<100J[b]	<50J[b]	<100J[b]	<50
BTEX (8020/8020 Mod.)												
Benzene	0.1	1	5	<1	230				<1	<1	<1	<1
Toluene	0.1	1	1,000	<1	580				<1	<1	<1	<1
Ethylbenzene	0.1	1	700	<1	13J				<1	<1	<1	<1
Xylenes (Total)	0.2	2	10,000	<2	200J				<2	<2	<2	<2
VOC 8260												
Benzene	1	50	5	<1	562				NA	<1	<1	<1
cis-1,2-Dichloroethene	1	50	70	<1	1,020				NA	<1	<1	<1
Methylene Chloride	1	50	5	<1	161				NA	<1	<1	<1
Tetrachloroethene	1	50	5	<1	1,830				NA	<1	<1	<1
Toluene	1	50	1,000	<1	1,220				NA	<1	<1	<1
Trichloroethene	1	50	5	<1	285				NA	<1	<1	<1
Xylenes (Total)	1	100	10,000	<2	518				NA	<2	<2	<2

☐ CT&E Data.
■ F&B Data.
NA Not analyzed.
J Result is an estimate.
b GRPH concentrations reported for these samples are equivalent to gasoline range organics (GRO) as defined by ADEC.

TABLE G-6. POL STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: POL Storage (SS04)

Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Sample				Field Blanks			Lab Blanks
					SW01				AB01	EB01	TB01	
Laboratory Sample ID Numbers					512 514 4355-3				906	530 534 4357-1	528 4357-8	#3&4-82593 4355
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L				µg/L	µg/L	µg/L	µg/L
SVOC 8270												
Phenol	10	29		<10.2-<11	27.6J				NA	<29	NA	<10
4-Methylphenol	1	29		<10.2-<11	110				NA	<29	NA	<10
Naphthalene	1	29		<10.2-<11	18.8J				NA	<29	NA	<10
TOC	5,000	5,000		25,200-28,700	52,900				NA	<5,000	NA	<5,000
TSS	100	200		5,000-12,000	130,000				NA	NA	NA	<200
TDS	10,000	10,000		253,000-424,000	681,000				NA	NA	NA	<10,000

☐ CT&E Data.
NA Not analyzed.
J Result is an estimate.

TABLE G-6. POL STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: POL Storage (SS04)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL
(DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample					Field Blank	Lab Blanks
					SW01					EB01	
Laboratory Sample ID Numbers					4355-3					4357-1	4355 4357
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L					µg/L	µg/L
Aluminum	17.4	100		<100-350 (<100-340)	130 (<100)J					<100	<100
Antimony	N/A	100	6	<100 (<100)	<100 (<100)					<100	<100
Arsenic	5.3	100	50	<100 (<100)	<100 (<100)					<100	<100
Barium	1.2	50	2,000	<50-93 (<50-91)	340 (250)					<50	<50
Beryllium	N/A	50	4	<50 (<50)	<50 (<50)					<50	<50
Cadmium	1.7	50	5	<50 (<50)	<50 (<50)					<50	<50
Calcium	34.5	200		4,500-88,000 (4,100-86,000)	95,000J (97,000)					270	<200
Chromium	3.29	50	100	<50 (<50)	<50 (<50)					<50	<50
Cobalt	N/A	100		<100 (<100)	<100 (<100)					<100	<100
Copper	2.3	50	1,300	<50 (<50)	<50 (<50)					<50	<50
Iron	25	100		180-2,800 (<100-1,600)	2,600 (8,500)					<100	<100
Lead	6.6	100	15	<100 (<100)	<100 (<100)					<100	<100

☐ CT&E Data.
N/A Not available
J Result is an estimate.

TABLE G-6. POL STORAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: POL Storage (SS04)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL
(DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample					Field Blank	Lab Blanks
					SW01					EB01	
Laboratory Sample ID Numbers					4355-3					4357-1	4355 4357
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L					µg/L	µg/L
Magnesium	47.8	200		<5,000-53,000 (2,600-54,000)	35,000 (36,000)					<200	<200
Manganese	1.24	50		<50-510 (<50-120)	3,100 (3,000)					<50	<50
Molybdenum	N/A	50		<50 (<50)	<50 (<50)					<50	<50
Nickel	5.5	50	100	<50 (<50)	<50 (<50)					<50	<50
Potassium	1,154	5,000		<5,000 (<5,000)	8,300 (8,100)					<5,000	<5,000
Selenium	62.4	100	50	<100 (<100)	<100 (<100)					<100	<100
Silver	2.6	50	50	<50 (<50)	<50J (<50)J					<50J	<50
Sodium	27.7	250		8,400-410,000 (8,200-450,000)	83,000 (80,000)					370J	<250 (<250)
Thallium	0.57	5	2	<5 (<5)	<5J (<5)					<5	<5
Vanadium	1.8	50		<50 (<50)	<50 (<50)					<50	<50
Zinc	8.2	50		<50-160 (<50)	<50 (220)					<50	<50-1,894 (196)

☐ CT&E Data.
N/A Not available
J Result is an estimate.

TABLE G-7. DIESEL SPILLS ANALYTICAL DATA SUMMARY

Installation: Point Lonely
Site: Diesel Spills (SS05)
Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks	
					S01	S02-0.3	S03	S04-0.3	S05	AB01	EB02	TB02		
Laboratory Sample ID Numbers					708	710	714	718	720	906	694/696	684	#5-82793 #3&4-82593	#6-82693 #1&2-82893
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5-10	50-100	500[a]	<190[b]-150J[b]	<50[b]	<50[b]	<50[b]	<50[b]	<100[b]	NA	<1,000[b]	NA	<1,000	<50
GRPH	0.2-1.0	2-10	100	<20J[b]-27J[b]	<10J[b]	<2J[b]	<2J[b]	<2J[b]	<5J[b]	<100J[b]	<100[b]	<100J[b]	<50	<2
RRPH (Approx.)	10-20	100-200	2,000[a]	<180-<870	<100	<100	<100	<100	<200	NA	<2,000	NA	<2,000	<100
BTEX (8020/8020 Mod)			10 Total BTEX	<1.0-2.7J	<0.20J	<0.10	<0.10	<0.10	<0.25					
Benzene	0.002-0.005	0.02-0.05	0.5	<0.04-<0.3	<0.04J	<0.02	<0.02	<0.02	<0.05	<1	<1	<1	<1	<0.02
Toluene	0.002-0.005	0.02-0.05		<0.2-0.5	<0.04J	<0.02	<0.02	<0.02	<0.05	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002-0.005	0.02-0.05		<0.2-0.2	<0.04J	<0.02	<0.02	<0.02	<0.05	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004-0.010	0.04-0.10		<0.4-2.0J	<0.08J	<0.04	<0.04	<0.04	<0.10	<2	<2	<2	<2	<0.04

▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-7. DIESEL SPILLS ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Diesel Spills (SS05)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks	
					S06-1	S07	S08-1	S11-3.5	S12-3	AB01	EB02	TB02		
Laboratory Sample ID Numbers					728	722 4501-1	730	760	758	906	694/696	684	#5-82793 #3&4-82593	#6-82693 #1&2-82893
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	7-8	70-80	500[a]	<190[b]-150J[b]	<70[b]	<80[b]	<70[b]	930J[b]	1,400J[b]	NA	<1,000[b]	NA	<1,000	<50
GRPH	0.3-5	3-50	100	<20J[b]-27J[b]	7J[b]	<5J[b]	<3J[b]	100J[b]	<50J[b]	<100J[b]	<100[b]	<100J[b]	<50	<2
RRPH (Approx.)	11-17	110-170	2,000[a]	<180-<870	<140	<170	<140	<110	<110	NA	<2000	NA	<2,000	<100
BTEX (8020/8020 Mod)			10 Total BTEX	<1.0-2.7J	0.4J	<0.25	<0.15	5.0J	<4.52J					
Benzene	0.002-0.005	0.02-0.05	0.5	<0.04-<0.3	<0.03	<0.05	<0.03	<0.02	<0.02J	<1	<1	<1	<1	<0.02
Toluene	0.002-0.005	0.03-0.05		<0.2-0.5	<0.03	<0.05	<0.03	NA	<0.2J	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002-0.005	0.02-0.05		<0.2-0.2	0.2	<0.05	<0.03	NA	<0.3J	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.006-0.010	0.06-0.1		<0.4-2.0J	0.2J	<0.1	<0.06	5.0J	<4J	<2	<2	<2	<2	<0.04

■ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-7. DIESEL SPILLS ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Diesel Spills (SS05)
Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples: S13-3 & S19-3 (Replicates)		Environmental Samples: S14-3	Environmental Samples: S15-2.5	Field Blanks: AB01	Field Blanks: EB02	Field Blanks: TB02	Lab Blanks	
Laboratory Sample ID Numbers					756	746	754	752	906	694/696	684	#5-82793 #3&4-82593	#6-82693 #1&2-82893
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5	50	500[a]	<190[b]-150J[b]	280J[b]	290J[b]	4,300J[b]	50J[b]	NA	<1,000[b]	NA	<1,000	<50
GRPH	0.2	2	100	<20J[b]-27J[b]	54J[b]	47J[b]	120J[b]	<2J[b]	<100J[b]	<100[b]	<100J[b]	<50	<2
RRPH (Approx.)	10	100	2,000[a]	<180-<670	<100	<100	<100	<100	NA	<2,000	NA	<2,000	<100
BTEX (8020/8020 Mod)			10 Total BTEX	<1.0-2.7J	4.7J	3.8J	9.7	<0.10					
Benzene	0.002	0.02	0.5	<0.04-<0.3	<0.02	<0.02	<0.02	<0.02	<1	<1	<1	<1	<0.02
Toluene	0.002	0.02		<0.2-0.5	0.4	0.3	0.7	<0.02	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002	0.02		<0.2-0.2	0.3	0.5	3	<0.02	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004	0.04		<0.4-2.0J	4J	3J	6J	<0.04	<2	<2	<2	<2	<0.04

▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-7. DIESEL SPILLS ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Diesel Spills (SS05)
Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks			Lab Blanks	
					S16-5	S17-3	S18-2.5	AB01	EB02	TB02		
Laboratory Sample ID Numbers					750	748	732	906	694/696	684	#5-82793 #3&4-82593	#6-82693 #1&2-82893
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5	50	500[a]	<190[b]-150J[b]	50J[b]	<50[b]	1,300J[b]	NA	<1,000[b]	NA	<1,000	<50
GRPH	0.2-2	2-20	100	<20J[b]-27J[b]	9J[b]	<20J[b]	80J[b]	<100J[b]	<100[b]	<50[b]	<50[b]	<2
RRPH (Approx.)	10	100	2,000[a]	<180-<670	<100	<100	<100	NA	<2,000	NA	<2,000	<100
BTEX (8020/8020 Mod)			10 Total BTEX	<1.0-2.7J	2.28J	<1.0J	9.0J					
Benzene	0.002-0.02	0.02-0.2	0.5	<0.04-<0.3	<0.02	<0.2J	<0.02	<1	<1	<1	<1	<0.02
Toluene	0.002-0.02	0.02-0.2		<0.2-0.5	0.03	<0.2J	<0.02	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002-0.02	0.02-0.2		<0.2-0.2	0.25	<0.2J	2.0	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004-0.04	0.04-0.4		<0.4-2.0J	2J	<0.4J	7.0J	<2	<2	<2	<2	<0.04

▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-7. DIESEL SPILLS ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Diesel Spills (SS05)

Matrix: Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks			Lab Blanks	
					SD01	SD02	SD03	SD04	AB01	EB02	TB02		
Laboratory Sample ID Numbers					712	716	702	726	906	694/696	684	#5-82793 #3&4-82593	#6-82693 #1&2-82893
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5-36	50-360	500[a]	<180[b]-150J[b]	<50[b]	<360[b]	600J[b]	1,300J[b]	NA	<1,000[b]	NA	<1,000	<50
GRPH	0.2-4	2-40	100	<20J[b]-27J[b]	<2J[b]	<7J[b]	<40J[b]	80J[b]	<100J[b]	<100J[b]	<100J[b]	<50	<2
RRPH (Approx.)	1-71	10-710	2,000[a]	<180-<670	<110	<710	<120	420	NA	<2,000	NA	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<1.0-2.7J	<0.10	<1.20J	<4.6J	10.2J					
Benzene	0.002-0.014	0.02-0.14	0.5	<0.04-<0.3	<0.02	<0.14J	<0.4J	1.2J	<1	<1	<1	<1	<0.02
Toluene	0.002-0.014	0.02-0.14		<0.2-0.5	<0.02	<0.14J	<0.4J	2.0	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002-0.014	0.02-0.14		<0.2-0.2	<0.02	<0.14J	<1.4J	2.0	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004-0.028	0.04-0.28		<0.4-2.0	<0.04	<0.28J	<2.4J	5.0J	<2	<2	<2	<2	<0.04

▒ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-7. DIESEL SPILLS ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Diesel Spills (SS05)

Matrix: Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks			Lab Blanks	
					SD05	SD06	SD07-1 & SD08-1 (Replicates)		AB01	EB02	TB02		
Laboratory Sample ID Numbers					698	686	724 4504-10	704 4506-5	906	694/696 4506-1	684 4505-3	4505/4506 #5-82793 #3&4-82593	4504/4506 #6-82693 #1&2-82893
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	7-13	70-130	500[a]	<190[b]-150J[b]	240J[b]	690J[b]	<70[b]	90J[b]	NA	<1,000[b]	NA	<1,000	<50
GRPH	0.2-1.0	2-10	100	<20J[b]-27J[b]	<10J[b]	<10J[b]	<3J[b]	<2J[b]	<100J[b]	<100[b]	<100J[b]	<50	<2
RRPH (Approx.)	13-59	130-590	2,000[a]	<180-<670	<260	<590	<130	<180	NA	<2,000	NA	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<1.0-2.7J	<0.5	<0.5	<0.12	<0.20					
Benzene	0.003-0.01	0.03-0.1	0.5	<0.04-<0.3	<0.1	<0.1	<0.03	<0.04	<1	<1	<1	<1	<0.02
Toluene	0.003-0.01	0.03-0.1		<0.2-0.5	<0.1	<0.1	<0.03	<0.04	<1	<1	<1	<1	<0.02
Ethylbenzene	0.003-0.01	0.03-0.1		<0.2-0.2	<0.1	<0.1	<0.03	<0.04	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.006-0.02	0.06-0.2		<0.4-2.0J	<0.2	<0.2	<0.06	<0.08	<2	<2	<2	<2	<0.04
VOC 8260	0.020	0.030-0.350		<0.300-2.267	NA	NA	<0.030	<0.35	NA	<1	<1	<1	<0.020
SVOC 8270	0.200	2.00		<5.00-<30.0	NA	NA	<2.00	NA	NA	<10.2	NA	<10	<0.200
TOC				99,600-473,000	NA	NA	46,100	437,000	NA	<5,000	NA	<5,000	NA

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-7. DIESEL SPILLS ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Diesel Spills (SS05)
Matrix: Soil/Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blank	Lab Blanks	
					2S19-3	2SD09	2SD10	2SD11	EB05		
Laboratory Sample ID Numbers					1787 4626-1	1788 4626-2	1789	1790	1796/1798 4626-6	#6-9993 4626	4626
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	mg/kg
DRPH	4.00-7	4.00-70	500[a]	<190[b]-150J[b]	419J[ce]	188J[ce]	<70[b]	<70[b]	<200[d]	<200-<1,000	<4.00
GRPH	0.400	0.700-1	100	<20J[b]-27J[b]	<1	<0.700	NA	NA	<20[d]	<20	<0.400
RRPH (Approx.)	14	140	2,000[a]	<180-<670	<140	<140	<140	<140	<2,000	<2,000	NA

- ☐ CT&E Data.
- ▩ F&B Data.
- NA Not analyzed.
- J Result is an estimate.
- a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
- b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
- c These samples were analyzed by F&B also; DRPH were detected at <80[b] mg/kg for 2S19-3 and at <70[b] mg/kg for 2SD09.
- d This sample was analyzed by F&B also; DRPH and GRPH were detected at <1,000[b] and <50[b] µg/L, respectively.
- e The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE G-7. DIESEL SPILLS ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Diesel Spills (SS05)
Matrix: Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blank	Lab Blanks	
					2SD12	2SD13	2SD14	EB05		
Laboratory Sample ID Numbers					1791	1792	1793 4626-5	1796/1798 4626-6	#6-9993 #1&2-9793	4626
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	mg/kg
DRPH	4.00-9	4.00-90	500[a]	<190[b]-150J[b]	<90[b]	80J[b]	898[ce]	<200[d]	<200-<1,000	<4.00
GRPH	0.400	0.400	100	<20J[b]-27J[b]	NA	NA	30.2	<20[d]	<20-<50	<0.400
RRPH (Approx.)	12-20	120-200	2,000[a]	<180-<670	<200	<120	<140	<2,000	<2,000	NA

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c This sample was analyzed by F&B also; DRPH were detected at 220J[b] mg/kg.
d This sample was analyzed by F&B also; DRPH and GRPH were detected at <1,000[b] and <50[b] µg/L, respectively.
e The laboratory reported that the 188 mg/kg of the EPH pattern in this sample was not consistant distillate fuel.

TABLE G-7. DIESEL SPILLS ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Diesel Spills (SS05)

Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks
					SW01	SW02	SW03	SW04	SW05	AB01	EB02	TB02	
Laboratory Sample ID Numbers					658 660	667 668	675 678	679 680	762/764 767	906	694 696	684	#5-82793 #3&4-82593
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
DRPH	100	1,000		<1,000[b]	<1,000[b]	<1,000[b]	<1,000[b]	<1,000[b]	<1,000[b]	NA	<1,000[b]	NA	<1,000
GRPH	10	100		<100J[b]	<100J[b]	<100J[b]	240J[ab]	<100J[b]	<100[b]	<100J[b]	<100J[b]	<100J[b]	<50
RRPH (Approx.)	200	2,000		<2,000	<2,000	<2,000	<2,000	<2,000	<2,000	NA	<2,000	NA	<2,000
BTEX (8020/8020 Mod.)													
Benzene	0.1	1	5	<1	<1	<1	21	<1	<1	<1	<1	<1	<1
Toluene	0.1	1	1,000	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	0.1	1	700	<1	<1	<1	10J	<1	<1	<1	<1	<1	<1
Xylenes (Total)	0.2	2	10,000	<2	<2	<2	46J	<2	<2	<2	<2	<2	<2

▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a Total petroleum hydrocarbons in this water sample exceed the 15 µg/L stated for fresh water in ADEC's Water Quality Criteria 18AAC70 (ADEC 1989).
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-7. DIESEL SPILLS ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Diesel Spills (SS05)

Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks			Lab Blanks
					SW06	SW07 & SW08 (Duplicates)		AB01	EB02	TB02	
Laboratory Sample ID Numbers					772 774	738/739 4505-1	742/745 4505-2	906	694/696 4506-1	684 4505-3	#5-82793 #3&4-82593
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
DRPH	100	1,000		<1,000[b]	<1,000[b]	<1,000[b]	<1,000[b]	NA	<1,000[b]	NA	<1,000
GRPH	10	100		<100J[b]	<100[b]	<100[b]	<100[b]	<100J[b]	<100[b]	<100J[b]	<50
RRPH (Approx.)	200	2,000		<2,000	<2,000	<2,000	<2,000	NA	<2,000	NA	<200
BTEX (8020/8020 Mod.)											
Benzene	0.1	1	5	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	0.1	1	1,000	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	0.1	1	700	<1	<1	<1	<1	<1	<1	<1	<1
Xylenes (Total)	0.2	2	10,000	<2	<2	<2	<2	<2	<2	<2	<2
VOC 8260											
Chloromethane	1	1		<1	NA	<1J	2.3J	NA	<1	<1	<1
1,2-Dichloroethane	1	1	5	4.9-7.9	NA	4.4	4J	NA	<1	<1	<1
SVOC 8270	10	11		<10.2-<11	NA	<11-<11J	<11-<11J	NA	<10.2-<10.2J	NA	<10
TOC	5,000	5,000		25,200-28,700	NA	178,000	254,000	NA	<5,000	NA	<5,000
TSS	100	100		5,000-12,000	NA	1,440,000	8,260,000	NA	NA	NA	<100
TDS	10,000	10,000		253,000-424,000	NA	298,000	326,000	NA	NA	NA	12,000

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-8. OLD DUMP SITE ANALYTICAL DATA SUMMARY

Installation: Point Lonely
Site: Old Dump Site (LF07)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples: S01 & S08 (Relicates)	Environmental Samples: S01 & S08 (Relicates)	Environmental Samples: S02	Environmental Samples: S03	Environmental Samples: S04	Field Blanks: AB02	Field Blanks: EB03	Field Blanks: TB03	Lab Blanks	Lab Blanks
Laboratory Sample ID Numbers					992	994	914	966 4425-7	968	1094	942/944 4425-9	916 4425-8	#5-83093 #5-82893 #1&2-82893 4425	#6-82893 4425
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5-6	50-60	500[a]	<180[b]-150J[b]	<50[b]	<50[b]	<60[b]	<50[b]	80J[b]	NA	<1,000[b]	NA	<1,000	<50
GRPH	0.2-0.3	2-3	100	<20J[b]-27J[b]	<2J[b]	<2J[b]	<3J[b]	<2J[b]	<2J[b]	<50J[b]	<100J[b]	<100J[b]	NA	NA
RRPH (Approx.)	10-12	100-120	2,000[a]	<180-<670	180	<100	<120	<100	1,500	NA	<2,000	NA	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<1-2.7J	<0.10	<0.10	<0.18	<0.10	<0.10					
Benzene	0.002-0.003	0.02-0.03	0.5	<0.04-<0.3	<0.02	<0.02	<0.03	<0.02	<0.02	<1	<1	<1	<1	NA
Toluene	0.002-0.003	0.02-0.03		<0.2-0.5	<0.02	<0.02	<0.03	<0.02	<0.02	<1	<1	<1	<1	NA
Ethylbenzene	0.002-0.005	0.02-0.05		<0.2-0.2	<0.02	<0.02	<0.05	<0.02	<0.02	<1	<1	<1	<1	NA
Xylenes (Total)	0.004-0.005	0.04-0.05		<0.4-2.0J	<0.04	<0.04	<0.05	<0.04	<0.04	<2	<2	<2	<2	NA
HVOC 8010	0.002	0.02		<0.04-<0.3	<0.02	<0.02	<0.02	<0.02	<0.02	<1	<1	<1	NA	NA
VOC 8260	0.020	0.020		<0.300-<0.500	NA	NA	NA	<0.020J	NA	NA	<1-1.3	<1	<1	<0.020
SVOC 8270	0.200	0.200-0.866		<5.00-<30.0	NA	NA	NA	<0.200-0.866U	NA	NA	<12	NA	<10	<0.200
PCBs	0.01	0.1	10	<0.1-<0.7	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<2	NA	<2	<0.1
TOC				99,600-473,000	NA	NA	NA	9,040	NA	NA	<5,000	NA	<5,000	NA

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
U Compound is not present above the concentration listed.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-8. OLD DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Old Dump Site (LF07)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks			Lab Blanks	
					S05	S06	S07	AB02	EB03	TB03		
Laboratory Sample ID Numbers					910	912	996	944	942/944	916	#5-83093 #5-82893 #1&2-82893	#6-82893
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5-6	50-60	500[a]	<180[b]-150J[b]	<50[b]	270J[b]	<60[b]	NA	<1,000[b]	NA	<1,000	<50
GRPH	0.2	2	100	<20J[b]-27J[b]	<2J[b]	<2J[b]	<2J[b]	<50J[b]	<100J[b]	<100J[b]	NA	NA
RRPH (Approx.)	10	100	2,000[a]	<180-<670	<100	5,900	120	NA	<2000	NA	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<1.0-2.7J	<0.10	<0.10	<0.10					
Benzene	0.002	0.02	0.5	<0.04-<0.3	<0.02	<0.02	<0.02	<1	<1	<1	<1	NA
Toluene	0.002	0.02		<0.2-0.5	<0.02	<0.02	<0.02	<1	<1	<1	<1	NA
Ethylbenzene	0.002	0.02		<0.2-0.2	<0.02	<0.02	<0.02	<1	<1	<1	<1	NA
Xylenes (Total)	0.004	0.04		<0.4-2.0J	<0.04	<0.04	<0.04	<2	<2	<2	<2	NA
HVOC 8010	0.002	0.02		<0.04-<0.3	<0.02	<0.02	<0.02	<1	<1	<1	NA	NA
PCBs	0.01	0.1	10	<0.1-<0.7	<0.1	<0.1	<0.1	NA	<2	NA	<2	<0.1

▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-8. OLD DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Old Dump Site (LF07)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blank	Lab Blanks	
					2S08	2S09-1			EB08		
Laboratory Sample ID Numbers					1778	1779			1774	#6-9993	#5-9693
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg			μg/L	μg/L	mg/kg
DRPH	7-30	70-300	500[a]	<190[b]-150J[b]	<300[b]	<70[b]			289J[cd]	<1,000	<50
RRPH (Approx.)	14-60	140-600	2,000[a]	<180-<670	<600	<140			<2,000	<2,000	<100

☐ CT&E Data.
▓ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH concentrations reported for these samples are equivalent to diesel range organics (DRO) as defined by ADEC.
c This sample was analyzed by F&B also; DRPH were detected at <1,000[b] μg/L.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE G-8. OLD DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely Site: Old Dump Site (LF07)	Matrix: Soil Units: mg/kg		METALS ANALYSES						
Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample			Field Blank	Lab Blank
					S03			EB03	
Laboratory Sample ID Numbers					4425-7			4425-9	4425
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg			µg/L	µg/L
Aluminum	0.35	1,600		1,500-25,000	<1,600			<100	<100
Antimony	N/A	48		<7.8-<230	<48			<100	<100
Arsenic	0.11	48		<4.9-8.5	<48			<100	<100
Barium	0.024	1		27-390	65			<50	<50
Beryllium	N/A	2.4		<2.6-6.4	<2.4			<50	<50
Cadmium	0.33	2.4		<3.0-<36	<2.4			<50	<50
Calcium	0.69	4		360-59,000	53,000J			250	<200
Chromium	0.066	2.4		<4.3-47	<2.4			<50	<50
Cobalt	N/A	4.8		<5.1-12	<4.8			<100	<100
Copper	0.045	24		<2.7-45	<24			<50	<50
Iron	0.50	2		5,400-35,000	8,200			<100	<100
Lead	0.13	48		<5.1-22	<48			<100	<100
Magnesium	0.96	4		360-7,400	30,000J			<200	<200
Manganese	0.025	1		25-290	110			<50	<50
Molybdenum	N/A	2.4		<2.5-<11	<2.4			<50	<50
Nickel	0.11	1		4.2-46	3.7			<50	<50
Potassium	23	100		<300-2,200	370			<5,000	<5,000

☐ CT&E Data.
N/A Not available.
J Result is an estimate.

TABLE G-8. OLD DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely Site: Old Dump Site (LF07)	Matrix: Soil Units: mg/kg		METALS ANALYSES						
Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample			Field Blank	Lab Blank
					S03			EB03	
Laboratory Sample ID Numbers					4425-7			4425-9	4425
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg			µg/L	µg/L
Selenium	1.2	48		<7.8-<170	<48			<100	<100
Silver	0.53	24		<3-<110	<24R			<50	<50
Sodium	0.55	5		<160-680	120			420	<250
Thallium	0.011	0.26		<0.2-<1.2	<0.26			<5	<5
Vanadium	0.036	1		6.3-59	15			<50	<50
Zinc	0.16	1		9.2-95	7.5			<50	<50

☐ CT&E Data.
R Result has been rejected.

TABLE G-8. OLD DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Old Dump Site (LF07)

Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples		Field Blanks					Lab Blanks
					SW01	SW02	AB02	EB03	EB04	TB03	TB04	
Laboratory Sample ID Numbers					1090 1088	990 988 4428-2	1094	942/944 4425-9	1098 1100 4426-4	916 4425-8	1092 4426-3	#5-83093 #5-82893 #1&2-82893 4425/4426
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
DRPH	100	1,000		<1,000b	<1,000Jb	<1,000b	NA	<1,000b	<1,000Jb	NA	NA	<1,000
GRPH	5-10	50-100		<100Jb	<50Jb	<100Jb	<50Jb	<100Jb	<50Jb	<100Jb	<50Jb	NA
RRPH (Approx.)	200	2,000		<2,000	<2,000	<2,000	NA	<2,000	<2,000	NA	NA	<2,000
BTEX (8020/8020 Mod.)												
Benzene	0.1	1	5	<1	<1	<1	<1	<1	<2J	<1	<6J	<1
Toluene	0.1-0.2	1-2	1,000	<1	<2J	<1	<1	<1	<2J	<1	<4J	<1
Ethylbenzene	0.1-1	1-10	700	<1	<10J	<1	<1	<1	<2J	<1	<3J	<1
Xylenes (Total)	0.2-1.2	2-12	10,000	<2	<12J	<2	<1	<2	<2J	<2	<3J	<2
HVOC 8010	0.1	1		<1	<1	<1	NA	<1	<1	<1	<1	NA
VOC 8260	1	1		<1-7.9	NA	<1	NA	<1-1.3	<1	<1	<1	<1
PCBs	0.2	2	0.5	<2	<2J	<2	NA	<2	<2	NA	NA	<2
TOC	5,000	5,000		25,200-28,700	NA	32,600	NA	<5,000	<5,000	NA	NA	<5,000
TSS	100	100		5,000-12,000	NA	4,500	NA	NA	NA	NA	NA	<100
TDS	10,000	10,000		253,000-424,000	NA	972,000	NA	NA	NA	NA	NA	<10,000

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-8. OLD DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Old Dump Site (LF07)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample					Field Blank	Lab Blanks
					SW02					EB03	
Laboratory Sample ID Numbers					4428-2					4425-9	4425 4428
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L					µg/L	µg/L
Aluminum	17.4	100		<100-350 (<100-340)	<430 (<100)					<100	<100
Antimony	N/A	100	6	<100 (<100)	<100 (<100)					<100	<100
Arsenic	5.3	100	5	<100 (<100)	<100 (<100)					<100	<100
Barium	1.2	50	2,000	<50-93 (<50-91)	170 (120)					<50	<50
Beryllium	N/A	50	4	<50 (<50)	<50 (<50)					<50	<50
Cadmium	1.7	50	5	<50 (<50)	<50 (<50)					<50	<50
Calcium	34.5	200		4,500-88,000 (4,100-86,000)	80,000 (78,000)					250	250
Chromium	3.29	50	100	<50 (<50)	<50 (<50)					<50	<50
Cobalt	N/A	100		<100 (<100)	<100 (<100)					<100	<100
Copper	2.3	50	1,300	<50 (<50)	<50 (<50)					<50	<50
Iron	25	1000		180-2,800 (<100-1,600)	11,000 (<100)					<100	<100
Lead	6.6	100		<100 (<100)	<100 (<100)					<100	<100

☐ CT&E Data.
N/A Not available.

TABLE G-8. OLD DUMP SITE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Old Dump Site (LF07)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample					Field Blank	Lab Blanks
					SW02					EB03	
Laboratory Sample ID Numbers					4428-2					4425-9	4425 4428
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L					µg/L	µg/L
Magnesium	47.8	200		<5,000-53,000 (2,600-54,000)	44,000 (42,000)J					<200	<200
Manganese	1.24	50		<50-510 (<50-120)	270 (69)					<50	<50
Molybdenum	N/A	50		<50 (<50)	<50 (<50)					<50	<50
Nickel	5.5	50	100	<50 (<50)	<50 (<50)					<50	<50
Potassium	1,154	5,000		<5,000 (<5,000)	<5,000 (<5,000)					<5,000	<5,000
Selenium	62.4	100	50	<100 (<100)	<100 (<100)					<100	<100
Silver	2.6	50	50	<50 (<50)	<50J (<50)					<50	<50
Sodium	27.7	250		8,400-410,000 (8,200-450,000)	130,000J (120,000)					420	420
Thallium	0.57	5	2	<5 (<5)	<5 (<5)					<5	<5
Vanadium	1.8	50		<50 (<50)	<50 (<50)					<50	<50
Zinc	8.2	50		<50-160 (<50)	<50 (<50)					<50	<50

☐ CT&E Data.
N/A Not available.
J Result is an estimate.

TABLE G-9. GARAGE ANALYTICAL DATA SUMMARY

Installation: Point Lonely
Site: Garage (SS09)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples: S01-1	Environmental Samples: S02-1	Environmental Samples: S03-1	Environmental Samples: S05 & S06 (Replicates)	Environmental Samples: S05 & S06 (Replicates)	Field Blanks: AB02	Field Blanks: EB04	Field Blanks: TB04	Lab Blanks	Lab Blanks
Laboratory Sample ID Numbers					998	1000	1004	1006 4427-1	1008	1094	1100 1098 4426-4	1092 4426-3	#5-83093 #1&2-82893 4426	#6-82893 #3&4-83193 4427
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	6-25	60-250	500[a]	<190[b]-150J[b]	4,100J[b]	12,000J[b]	18,000J[b]	<80J[b]	<100[b]	NA	<1,000J[b]	NA	<1,000	<50
GRPH	0.1-0.5	2-5	100	<20J[b]-27J[b]	170J[b]	240J[b]	400J[b]	<2J[b]	12J[b]	<50J[b]	<50J[b]	<50J[b]	NA	<2
RRPH (Approx.)	11-50	110-500	2,000[a]	<160-<670	3,100	4,000	10,000	<110	190	NA	<2,000	NA	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<1.0-2.7J	22.02J	12.5J	30.98J	<0.10	<0.52					
Benzene	0.002-0.01	0.02-0.1	0.5	<0.04-<0.3	0.28J	0.1J	<0.1	<0.02	<0.04	<1	<2J	<6J	<1	<0.02
Ethylbenzene	0.002-0.01	0.02-0.1		<0.2-0.5	6	1J	0.9	<0.02	<0.04	<1	<2J	<4J	<1	<0.02
Toluene	0.002-0.01	0.02-0.1		<0.2-0.2	0.74	0.4J	0.08J	<0.02	<0.04	<1	<2J	<3J	<1	<0.02
Xylenes (Total)	0.004-0.02	0.04-0.2		<0.4-2.0J	15J	11J	30J	<0.04	<0.4	<2	<2J	<3J	<2	<0.04
HVOC 8010														
Carbon Tetrachloride	0.002-0.004	0.02-0.04		<0.04-<0.3	0.05J	<0.02	<0.02	<0.02	<0.04	<1	<1	<1	NA	<0.02
Tetrachloroethene	0.002-0.004	0.02-0.04		<0.04-<0.3	7.8J	11J	18J	<0.02	<0.04	<1	<1	<1	NA	<0.02
Trichloroethene	0.002-0.05	0.02-0.5		<0.04-<0.3	0.5J	<0.02	<0.02	<0.02	<0.04	<1	<1	<1	NA	<0.02
VOC 8260														
Naphthalene	0.020	0.050		<0.300-0.211	NA	NA	NA	0.173	NA	NA	<1	<1	<1	<0.020
1,2,4-Trimethylbenzene	0.020	0.050		<0.300-0.956	NA	NA	NA	0.098	NA	NA	<1	<1	<1	<0.020
1,3,5-Trimethylbenzene	0.020	0.050		<0.300-0.409	NA	NA	NA	0.227	NA	NA	<1	<1	<1	<0.020
Xylenes (Total)	0.020	0.100		<0.600-2.267	NA	NA	NA	0.191	NA	NA	<1	<2	<2	<0.040

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-9. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Garage (SS09)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks	
					S01-1	S02-1	S03-1	S05 & S06 (Replicates)		AB02	EB04	TB04		
Laboratory Sample ID Numbers					998	1000	1004	1006 4427-1	1008	1094	1100 1098 4426-4	1092 4426-3	4426	#6-82893 4427
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
SVOC 8270														
di-n-Butylphthalate	0.200	7.20	8,000	<5.00-<30.0	NA	NA	NA	11.9B	NA	NA	<26	NA	<10	1.610
PCBs	0.01	0.1	10	<0.1-<0.7	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<2	NA	NA	<0.1

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
B Analyte was detected in the associated lab blank.

TABLE G-9. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Garage (SS09)
Matrix: Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples: SD01 & SD03 (Replicates)		Environmental Samples: SD02	Field Blanks: AB02	Field Blanks: EB04	Field Blanks: TB04	Lab Blanks	
Laboratory Sample ID Numbers					1022 4427-2	1020 4427-3	1034	1094	1098 1100 4426-4	1092 4426-3	#5-83093 #1&2-82893 4426	#6-82993 #3&4-83193 #1&2-82893 4427
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	9	90	500[a]	<190[b]-<150J[b]	NA	90J[b]	<90J[b]	NA	<1,000J[b]	NA	<1,000	<50
GRPH	0.2	2	100	<20J[b]-27J[b]	<2J[b]	6J[b]	<2J[b]	<50J[b]	<50J[b]	<50J[b]	NA	<2
RRPH(Approx.)	13	130	2,000[a]	<180-<670	NA	260	<130	NA	<2,000	NA	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<1.0-2.7J	<2.6	<2.6	<0.1					
Benzene	0.002	0.02	0.5	<0.04-<0.3	<0.02	<0.02	<0.02	<1	<2J	<6J	<1	<0.02
Ethylbenzene	0.002	0.02		<0.2-0.5	<0.02	<0.02	<0.02	<1	<2J	<4J	<1	<0.02
Toluene	0.002	0.02		<0.2-0.2	<0.02	<0.02	<0.02	<1	<2J	<3J	<1	<0.02
Xylenes (Total)	0.004-0.02	0.04-0.2		<0.4-2.0J	<0.20	<0.20	<0.04	<2	<2J	<3J	<2	<0.04
HVOC 8010	0.002	0.2		<0.04-<0.3	<0.02	<0.02	<0.02	<1	<1.0	<1.0	NA	<0.02
VOC 8260												
Xylenes (Total)	0.040	0.040		<0.600-2.267	0.045	0.069J	NA	NA	<2	<2	<2	<0.040
SVOC 8270												
di-n-Butylphthalate	0.200	0.200-3.30	8,000	<5.00-<30.0	15.3B	2.13U	NA	NA	<26	NA	<10	1.610
PCBs	0.01	0.1	10	<0.1-<0.7	NA	<0.1	<0.1	NA	<2	NA	NA	<0.1

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
B Analyte was detected in the associated blank.
J Result is an estimate.
U Compound is not present above the concentration listed.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-9. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Garage (SS09)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blank	Lab Blanks	
					2S04	2S06-1	2S07	EB08		
Laboratory Sample ID Numbers					1756 4626-7	1758 4626-8	1760 4626-11	1774 1776 4626-11	#6-9993 #5-83093 #1&2-9793 #1&2-82893 4626	#5-9693 #1&2-9793 4626
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	mg/kg
DRPH	6-25	60-250	500[a]	<190[b]-150J[b]	<250[b]	<60[b]	<250[b]	289J[cd]	<200-<1,000	<50
GRPH	0.1-0.5	1-5	100	<20J[b]-27J[b]	<5[b]	<1J[b]	<5J[b]	<20[c]	<20	<1
RRPH (Approx.)	12-50	120-500	2,000[a]	<180-<670	<500	<120	<500	<2,000	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<1.0-2.7J	<0.5	<0.1	<0.5			
Benzene	0.002-0.01	0.02-0.1	0.5	<0.04-<0.3	<0.1	<0.02	<0.1	<1	<1	<0.02
Ethylbenzene	0.002-0.01	0.02-0.1		<0.2-0.5	<0.1	<0.02	<0.1	<1	<1	<0.02
Toluene	0.002-0.01	0.02-0.1		<0.2-0.2	<0.1	<0.02	<0.1	<1	<1	<0.02-<0.03
Xylenes (Total)	0.004-0.02	0.04-0.2		<0.4-2.0J	<0.2	<0.04	<0.1	<2	<2	<0.04-<0.09
HVOC 8010	0.02-0.05	0.2-0.5		<0.04-<0.3	<0.5	<0.2	<0.5	<10	<1-<10	<0.04-<0.2
VOC 8260	0.020	0.025-0.400		<0.300-<0.500	<0.025J	<0.220	<0.400	<1-3.9	<1	<0.020

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c This sample was analyzed by F&B also; DRPH and GRPH were detected at <1,000[b] and <50[b] µg/L, respectively.
d The laboratory reported that the EPH pattern in this sample was not consistant with a middle distillate fuel.

TABLE G-9. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely Site: Garage (SS09)	Matrix: Soil/Sediment Units: mg/kg		METALS ANALYSES								
Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples					Field Blank	Lab Blank
					S05	SD01 & SD03 (Replicates)				EB04	
Laboratory Sample ID Numbers					4427-1	4427-2	4427-3			4426-4	4427
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg			µg/L	µg/L
Aluminum	0.35	2		1,500-25,000	2,900	2,100	1,800J			<100	<100
Antimony	N/A	49-93		<7.8-<230	<93	<49	<54			<100	<100
Arsenic	0.11	49-93		<4.9-8.5	<93	<49	<54			<100	<100
Barium	0.024	1		27-390	86	50	64J			<50	<50
Beryllium	N/A	25-46		<2.6-6.4	<46	<25	<27			<50	<50
Cadmium	0.33	2.5-4.6		<3.0-<36	<4.6	<2.5	<2.7			<50	<50
Calcium	0.69	4		360-59,000	130,000	39,000	63,000J			<200	<200
Chromium	0.066	2.5-4.6		<4.3-47	<4.6	<2.5	<2.7			<50	<50
Cobalt	N/A	4.9-9.3		<5.1-12	<9.3	<4.9	<5.4			<100	<100
Copper	0.045	1		<2.7-45	12	5.4	6.3			<50	<50
Iron	0.50	2		5,400-35,000	15,000	9,500	8,800			120	<100
Lead	0.13	4.9-9.3		<5.1-22	<9.3	<4.9	<5.1			<100	<100
Magnesium	0.96	4		360-7,400	72,000	22,000	37,000J			<200	<200
Manganese	0.025	1		25-290	200	91	110J			<50	<50
Molybdenum	N/A	2.5-4.6		<2.5-<11	<4.6	<2.5	<2.7J			<50	<50
Nickel	0.11	1		4.2-46	7	4.4	4			<50	<50

☐ CT&E Data.
■ F&B Data.
N/A Not available.
J Result is an estimate.

TABLE G-9. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Garage (SS09)

Matrix: Soil/Sediment
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples					Field Blank	Lab Blank
					S05	SD01 & SD03 (Replicates)				EB04	
Laboratory Sample ID Numbers					4427-1	4427-2	4427-3			4426-4	4427
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg			µg/L	µg/L
Potassium	23	100		<300-2,200	640	330	380			<5,000	<5,000
Selenium	1.2	49-93		<7.8-<170	<93	<49	<54			<100	<100
Silver	0.53	2.5-4.6		<3-<110	<2.5	<2.7	<2.7J			<50	<50
Sodium	0.55	5		<160-680	310	220	200			<250	<250
Thallium	0.011	0.25-0.47		<0.2-<1.2	<0.47	<0.25	<0.26			<5	<5
Vanadium	0.036	0.1		6.3-59	26	14	15			<50	<50
Zinc	0.16	1		9.2-95	19	14	11			<50	<50

☐ CT&E Data.
J Result is an estimate.

TABLE G-9. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely | Matrix: Surface Water
Site: Garage (SS09) | Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks
					SW01	SW02				AB02	EB04	TB04	
Laboratory Sample ID Numbers					1010 1012 4427-4	1016 1018 4427-5				1094	1098 1100 4426-4	1092 4426-3	#5-83093 #1&2-82893 4427
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L				µg/L	µg/L	µg/L	µg/L
DRPH	100	1,000		<1,000b	<1,000Jb	<1,000Jb				NA	<1,000Jb	NA	<1,000
GRPH	5	50		<100Jb	<50Jb	<50Jb				<50Jb	<50Jb	<50Jb	NA
RRPH (Approx.)	200	2,000		<2,000	<2,000	<2,000				NA	<2,000	NA	<2,000
BTEX (8020/8020 Mod.)													
Benzene	0.1	1	5	<1	2J	2J				<1	<2J	<6J	<1
Toluene	0.1	1	1,000	<1	6	<1				<1	<2J	<4J	<1
Ethylbenzene	0.1	1	700	<1	<1	<1				<1	<2J	<3J	<1
Xylenes (Total)	0.2	2	10,000	<2	6J	<2				<2	<2J	<3J	<2
HVOC 8010	0.1	1		<1	<1	<1				NA	<1	<1	NA
VOC 8260													
Benzene	1	1	5	<1	1.5	<1				NA	<1	<1	<1
Toluene	1	1	1,000	<1	4.8	<1				NA	<1	<1	<1
Xylenes (Total)	2	2	10,000	<2	3.8	<1				NA	<2	<2	<2
SVOC 8270	10	11-50		<10.2-<11	<50	<11				NA	<26	NA	<15
PCBs	0.2	2	0.5	<2	<2J	<2J				NA	<2	NA	NA

☐ CT&E Data.
■ F&B Data.
NA Not analyzed.
J Result is an estimate.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-9. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Garage (SS09)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL (DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples					Field Blank	Lab Blanks
					SW01	SW02				EB04	
Laboratory Sample ID Numbers					4427-4	4427-5				4426-4	4427 4426
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L				µg/L	µg/L
Aluminum	17.4	100		<100-350 (<100-340)	<100 (<100)	<100 (<100)				<100	<100
Antimony	N/A	100	6	<100 (<100)	<100 (<100)	<100 (<100)				<100	<100
Arsenic	5.3	100	50	<100 (<100)	<100 (<100)	<100 (<100)				<100	<100
Barium	1.2	50	2,000	<50-93 (<51-91)	290 (270)	250 (240)				<50	<50
Beryllium	N/A	50	4	<50 (<50)	<50 (<50)	<50 (<50)				<50	<50
Cadmium	1.7	50	5	<50 (<50)	<50 (<50)	<50 (<50)				<50	<50
Calcium	34.5	200		4,500-88,000 (4,100-86,000)	480 (470)	46,000 (45,000)				<200	<200
Chromium	3.29	50	100	<50 (<50)	<50 (<50)	<50 (<50)				<50	<50
Cobalt	N/A	100		<100 (<100)	<100 (<100)	<100 (<100)				<100	<100
Copper	2.3	50	1,300	<50 (<50)	<50 (<50)	<50 (<50)				<50	<50
Iron	25	100		180-2,800 (100-1,600)	1,400 (590)	1,200 (640)				120	<100
Lead	6.6	100	15	<100 (<100)	<100 (<100)	<100 (<100)				<100	<100

☐ CT&E Data.
N/A Not available.

TABLE G-9. GARAGE ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Garage (SS09)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL
(DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Samples					Field Blank	Lab Blanks
					SW01	SW02				EB04	
Laboratory Sample ID Numbers					4427-4	4427-5				4426-4	4427 4426
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L				µg/L	µg/L
Magnesium	47.8	200		<5,000-53,000) (2,600-54,000)	46,000 (46,000)	44,000 (44,000)				<200	<200
Manganese	1.24	50		<50-510 (<50-120)	<50 (<50)	<50 (<50)				<50	<50
Molybdenum	N/A	50		<50 (<50)	<50 (<50)	<50 (<50)				<50	<50
Nickel	5.5	50	100	<50 (<50)	<50 (<50)	<50 (<50)				<50	<50
Potassium	1,154	5,000		<5,000 (<5,000)	11,000 (11,000)	9,300 (9,600)				<5,000	<5,000
Selenium	62.4	100	50	<100 (<100)	<100 (<100)	<100 (<100)				<100	<100
Silver	2.6	50	50	<50 (<50)	<50J (<50)J	<50 (<50)				<50	<50
Sodium	27.7	250		8,400-410,000 (8,200-450,000)	150,000J (150,000)J	140,000 (14,000)				<250	<250
Thallium	.57	5	2	<5 (<5)	<5 (<5)	<5 (<5)				<5	<5
Vanadium	1.8	50		<50 (<50)	<50 (<50)	<50 (<50)				<50	<50
Zinc	8.2	50		<50-160 (<50)	<50 (<50)	<50 (<50)				<50	1,631 (<50-1,631)

☐ CT&E Data.
N/A Not available.
J Result is an estimate.

TABLE G-10. DIESEL TANK ANALYTICAL DATA SUMMARY

Installation: Point Lonely
Site: Diesel Tank (ST10)
Matrix: Soil/Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks	
					S01-1	SD01	SD02 & SD07 (Replicates)		SD03	AB02	EB04	TB04		
Laboratory Sample ID Numbers					1050	1030	1024	1026	1028 4426-1	1094	1098 1100 4428-4	1092 4426-3	#5-83093 #1&2-82893 4426	#6-82993 #3&4-83193 #1&2-82893 4426
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5	50	500[a]	<180[b]-150J[b]	<50[b]	390J[b]	250J[b]	900J[b]	650J[b]	NA	<1,000J[b]	NA	<1,000	<50
GRPH	0.2	2	100	<20J[b]-27J[b]	<2J[b]	12J[b]	380J[b]	130J[b]	12J[b]	<50J[b]	<50J[b]	<50J[b]	NA	<2
RRPH (Approx.)	10-20	100-200	2,000[a]	<180-<670	<100	<200	<150	<230	<120	NA	<2,000	NA	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<1.0-2.7J	0.2J	0.1J	<2.0J	<2.0	0.1J					
Benzene	0.002-0.05	0.02-0.5	0.5	<0.04-<0.3	<0.02	0.1J	<0.5J	<0.4	0.1J	<1	<2J	<6J	<1	<0.02
Toluene	0.002-0.05	0.02-0.5		<0.2-0.5	<0.02	<0.2	<0.5J	<0.4	<0.2	<1	<2J	<4J	<1	<0.02
Ethylbenzene	0.002-0.05	0.02-0.5		<0.2-0.2	<0.02	<0.2	<0.5J	<0.4	<0.2	<1	<2J	<3J	<1	<0.02
Xylenes (Total)	0.004-0.08	0.04-0.8		<0.4-2.0J	0.2J	<0.4	<0.5J	<0.8	<0.4	<2	<2J	<3J	<2	<0.04
VOC 8260														
1,3,5-Trimethylbenzene	0.020	0.250		<0.300-0.409	NA	NA	NA	NA	0.284	NA	<1	<1	<1	<0.020
SVOC 8270	0.200	0.250		<5.00-<30.0	NA	NA	NA	NA	<0.250	NA	<26	NA	<15	<0.200-1.160

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-10. DIESEL TANK ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Diesel Tank (ST10)

Matrix: Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks			Lab Blanks	
					SD04	SD05	SD06	AB02	EB04	TB04		
Laboratory Sample ID Numbers					1048 4426-1	1046	1052	1094	1100 1098 4426-4	1092 4426-3	#5-83093 #1&2-82893	#6-82993 #3&4-83193 #1&2-82893 4426
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5-9	50-90	500[a]	<190[b]-150J[b]	<90[b]	<50[b]	<60[b]	NA	<1,000J[b]	NA	<1,000	<50
GRPH	0.2-18	2-180	100	<20J[b]-27J[b]	<180J[b]	<2J[b]	<2J[b]	<50J[b]	<50J[b]	<50J[b]	NA	<2
RRPH (Approx.)	11-13	110-130	2,000[a]	<180-<670	<130	<110	<110	NA	<2,000	NA	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<1.0-2.7J	<1.0J	0.1J	0.1J					
Benzene	0.002-0.02	0.02-0.2	0.5	<0.04-<0.3	<0.2J	<0.02	<0.02	<1	<2J	<6J	<1	<0.02
Toluene	0.002-0.02	0.02-0.2		<0.2-0.5	<0.2J	<0.02	<0.02	<1	<2J	<4J	<1	<0.02
Ethylbenzene	0.002-0.02	0.02-0.2		<0.2-0.2	<0.2J	<0.02	<0.02	<1	<2J	<3J	<1	<0.02
Xylenes (Total)	0.004-0.04	0.04-0.4		<0.4-2.0	<0.4J	0.1J	0.1J	<2	<2J	<3J	<2	<0.04

▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-10. DIESEL TANK ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Diesel Tank (ST10)

Matrix: Soil/Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples 2S02-1.5	2S03-1.5	2S04-1.2	2SD08	2SD09	Field Blank EB08	Lab Blanks	
Laboratory Sample ID Numbers					1767	1772	1771	1768	1770 4626-12	1174 1176 4626-13	#5-83093 #1&2-82893 4626	#5-9693 #1&2-9793 4626
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	mg/kg
DRPH	5-15	50-150	500[a]	<190[b]-150J[b]	<60[b]	<50[b]	<150[b]	<70[b]	<60[b]	289J[cd]	<200-<1,000	<50
GRPH	0.1	1	100	<20J[b]-27J[b]	NA	NA	NA	NA	<1J[b]	<20[c]	<20	<1
RRPH (Approx.)	12-30	120-300	2,000[a]	<180-<670	<120	<120	<300	<140	<140	<2,000	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<1.0-2.7J	NA	NA	NA	NA	<0.1			
Benzene	0.002	0.02	0.5	<0.04-<0.3	NA	NA	NA	NA	<0.02	<1	<1	<0.02
Toluene	0.002	0.02		<0.2-0.5	NA	NA	NA	NA	<0.02	<1	<1	<0.02-<0.03
Ethylbenzene	0.002	0.02		<0.2-0.2	NA	NA	NA	NA	<0.02	<1	<1	<0.02
Xylenes (Total)	0.004	0.04		<0.4-2.0J	NA	NA	NA	NA	<0.04	<2	<2	<0.04-<0.09
VOC 8260	0.020	0.030		<0.050-<0.500	NA	NA	NA	NA	<0.030J	<1-3.9	<1	<0.020

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c This sample was analyzed by F&B also; DRPH and GRPH were detected at <1,000[b] and <50[b] µg/L, respectively.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE G-10. DIESEL TANK ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Diesel Tank (ST10)
Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks
					SW01	SW02				AB02	EB04	TB04	
Laboratory Sample ID Numbers					1054 1056	1058 1060 4426-2				1094	1098 1100 4426-4	1092 4426-3	#5-83093 #1&2-82893 4426
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L				µg/L	µg/L	µg/L	µg/L
DRPH	100	1,000		<1,000b	<1,000Jb	<1,000Jb				NA	<1,000Jb	NA	<1,000
GRPH	5	50		<100Jb	<50Jb	<50Jb				<50Jb	<50Jb	<50Jb	NA
RRPH (Approx.)	200	2,000		<2,000	<2,000	<2,000				NA	<2,000	NA	<2,000
BTEX (8020/8020 Mod.)													
Benzene	0.1-0.7	1-7	5	<1	<7J	<1				<1	<2J	<6J	<1
Toluene	0.1-0.3	1-3	1,000	<1	<3J	<1				<1	<2J	<4J	<1
Ethylbenzene	0.1-0.8	1-8	700	<1	<3J	<1				<1	<2J	<3J	<1
Xylenes (Total)	0.4-0.9	4-9	10,000	<2	<9J	<4J				<2	<2J	<3J	<2
VOC 8260													
1,2-Dichloroethane	1	1	5	<10	NA	2				NA	<1	<1	<1
SVOC 8270	10	10		<10.2-<11	NA	<10				NA	<26	NA	<15
TOC	5,000	5,000		25,200-28,700	NA	34,800				NA	<5,000	NA	<5,000
TSS	100	200		5,000-12,000	NA	16,000				NA	NA	NA	<200
TDS	10,000	10,000		253,000-424,000	NA	1,300,000				NA	NA	NA	<10,000

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-11. INACTIVE LANDFILL ANALYTICAL DATA SUMMARY

Installation: Point Lonely
Site: Inactive Landfill (LF11)

Matrix: Soil
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples: S01 & S05 (Replicates)	Environmental Samples: S01 & S05 (Replicates)	Environmental Samples: S02	Environmental Samples: S03	Environmental Samples: S04	Field Blanks: AB02	Field Blanks: EB03	Field Blanks: TB03	Lab Blanks	Lab Blanks
Laboratory Sample ID Numbers					946	954	948	950 4425-5	952	1094	942 4425-9	916 4425-8	#5-82893 4425	#6-82893 4425
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5-6	50-60	500[a]	<190[b]-150J[b]	<50[b]	<60[b]	<50[b]	<60[b]	<60[b]	NA	<1,000[b]	NA	<1,000	<50
GRPH	0.2-1	2-10	100	<20J[b]-27J[b]	<2J[b]	<2J[b]	<2J[b]	<2J[b]	<10J[b]	<50[b]	<100J[b]	<100J[b]	NA	NA
RRPH (Approx.)	10-12	100-120	2,000[a]	<180-<670	<100	<120	<100	<110	<100	NA	<2,000	NA	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<1.0-2.7J	<0.10	<0.10	<0.10	<0.10	<0.20J					
Benzene	0.002-0.04	0.02-0.4	0.5	<0.04-<0.3	<0.02	<0.02	<0.02	<0.02	<0.4J	<1	<1	<1	NA	NA
Toluene	0.002-0.04	0.02-0.4		<0.2-0.5	<0.02	<0.02	<0.02	<0.02	<0.4J	<1	<1	<1	NA	NA
Ethylbenzene	0.002-0.04	0.02-0.4		<0.2-0.2	<0.02	<0.02	<0.02	<0.02	<0.4J	<1	<1	<1	NA	NA
Xylenes	0.004-0.08	0.04-0.8		<0.4-2.0J	<0.04	<0.04	<0.04	<0.04	<0.8J	<2	<2	<2	NA	NA
HVOC 8010	0.002	0.02		<0.04-<0.3	<0.02	<0.02	<0.02	<0.02	<0.02	<1	<1	<1	NA	NA
VOC 8260														
1,2-Dichloroethane	0.020	0.020		<0.300-<0.500	NA	NA	NA	<0.020J	NA	NA	1.3	<1	<1	<0.020
SVOC 8270	0.200	0.220-2.82		<5.00-<30.0	NA	NA	NA	<0.220-2.82U	NA	NA	<1	NA	<1	<0.200-0.878
PCBs	0.01	0.1	10	<0.1-<0.7	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<2	NA	<2	<0.1
Pesticides	0.001-0.05	0.01-0.5		<0.02J-<0.5J	NA	NA	NA	<0.01J-<0.5J	NA	NA	<2	NA	NA	NA

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
U Compound is not present above the concentration listed.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-11. INACTIVE LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Inactive Landfill (LF11)
Matrix: Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks					Lab Blanks	
					SD01	SD02	SD03	AB02	EB03	EB04	TB03	TB04		
Laboratory Sample ID Numbers					956	958	960	1094	942/944	1098 1100	916	1092	#5-83093 #5-82893	#6-82893
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	6	60	500[a]	<190[b]-150J[b]	<60[b]	<60[b]	<60[b]	NA	<1,000[b]	<1,000J[b]	NA	NA	<1,000	<50
GRPH	0.2	2	100	<20J[b]-27J[b]	<2J[b]	8J[b]	<2J[b]	<50J[b]	<100J[b]	<50J[b]	<100J[b]	<50J[b]	NA	NA
RRPH (Approx.)	12	120	2,000[a]	<180-<670	<120	<120	<120	NA	<2,000	<2,000	NA	NA	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<1.0-2.7J	<0.10	1.4	<0.10							
Benzene	0.002-0.008	0.02-0.08	0.5	<0.04-<0.3	<0.02	<0.08	<0.02	<1	<1	<2J	<1	<6J	NA	NA
Toluene	0.002	0.02		<0.2-0.5	<0.02	<0.02	<0.02	<1	<1	<2J	<1	<4J	NA	NA
Ethylbenzene	0.002	0.02		<0.2-0.2	<0.02	0.2	<0.02	<1	<1	<2J	<1	<3J	NA	NA
Xylenes (Total)	0.004	0.04		<0.4-2.0J	<0.04	1.2	<0.04	<2	<2	<2J	<2	<3J	NA	NA
HVOC 8010	0.002	0.02		<0.04-<0.3	<0.02	<0.02	<0.02	<1	<1	<1	<1	<1	NA	NA
PCBs	0.01	0.1	10	<0.1-<0.7	<0.1	<0.1	<0.1	NA	<2	<2	NA	NA	<2	<0.1

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-11. INACTIVE LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely Site: Inactive Landfill (LF11)	Matrix: Soil Units: mg/kg		METALS ANALYSES								
Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample					Field Blank	Lab Blank
					S03					EB03	
Laboratory Sample ID Numbers					4425-5					4425-9	4425
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					µg/L	µg/L
Aluminum	0.35	2		<1,500-25,000	4,300					<100	<100
Antimony	N/A	53		<7.8-<230	<53J					<100	<100
Arsenic	0.11	53		<4.9-8.5	<53					<100	<100
Barium	0.024	1		28-390	110					<50	<50
Beryllium	N/A	27		<2.6-6.4	<27					<50	<50
Cadmium	0.33	2.7		<3.0-<36	<2.7					<50	<50
Calcium	0.69	4		360-59,000	50,000					250	283
Chromium	0.066	1		<4.3-47	9.0J					<50	<50
Cobalt	N/A	5.3		<5.1-12	<5.3					<100	<100
Copper	0.045	1		<2.7-45	4.7					<50	<50
Iron	0.50	2		5,400-35,000	12,000					<100	107
Lead	0.13	5.3		<5.1-22	<5.3					<100	<100
Magnesium	0.96	4		360-7,400	29,000					<200	<200
Manganese	0.025	1		25-290	130					<50	<50
Molybdenum	N/A	2.7		<2.5-<11	<2.7					<50	<50
Nickel	0.11	1		4.2-46	6.9					<50	<50
Potassium	23	100		<300-2,200	410J					<5,000	<5,000

☐ CT&E Data.
N/A Not available.
J Result is an estimate.

TABLE G-11. INACTIVE LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Inactive Landfill (LF11)

Matrix: Soil
Units: mg/kg

METALS ANALYSES

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample					Field Blank	Lab Blank
					S03					EB03	
Laboratory Sample ID Numbers					4425-5					4425-9	4425
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg					µg/L	µg/L
Selenium	1.3	5.3		<7.8-<170	<5.3					<100	<100
Silver	0.53	2.7		<3-<110	<2.7J					<50	<50
Sodium	0.55	5		<160-680	320J					420	<250
Thallium	0.011	0.26		<0.2-<1.2	<0.26					<5	<5
Vanadium	0.036	1		6.3-59	23					<50	<50
Zinc	0.16	1		9.2-95	14					<50	<50

☐ CT&E Data.
J Result is an estimate.

TABLE G-11. INACTIVE LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Inactive Landfill (LF11)

Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks
					SW01	SW02	SW03			AB02	EB03	TB03	
Laboratory Sample ID Numbers					892 894 4428-1	896 898	902 904			1094	942 944 4425-9	916	#5-82893 4428 4425
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L			µg/L	µg/L	µg/L	µg/L
DRPH	100	1,000		<1,000[b]	<1,000[b]	<1,000[b]	<1,000[b]			NA	<1,000[b]	NA	<1,000
GRPH	10	100		<100J[b]	<100J[b]	<100J[b]	200J[ab]			<50J[b]	<100J[b]	<100J[b]	NA
RRPH (Approx.)	200	2,000		<2,000	<2,000	<2,000	<2,000			NA	<2,000	NA	<2,000
BTEX (8020/8020 Mod.)													
Benzene	0.1	1	5	<1	<1	<1	4			<1	<1	<1	NA
Toluene	0.1	1	1,000	<1	<1	<1	17			<1	<1	<1	NA
Ethylbenzene	0.1	1	700	<1	<1	<1	<1			<1	<1	<1	NA
Xylenes (Total)	0.2	2	10,000	<2	<2	<2	7J			<2	<2	<2	NA
HVOC 8010	0.1	1		<1	<1	<1	<1			<1	<1	<1	NA
VOC 8260	1	1		<1-7.9	<1	NA	NA			NA	<1-1.3	NA	<1
SVOC 8270	10	20		<10.2-<11	<20	NA	NA			NA	<12	NA	<10
PCBs	0.2	2	0.5	<2	<2J	<2	<2			NA	<2	NA	<2
TOC	5,000	5,000		25,200-28,700	28,100	NA	NA			NA	<5,000	NA	<5,000
TSS	100	200		5,000-12,000	5,000	NA	NA			NA	NA	NA	<200
TDS	10,000	10,000		253,000-424,000	768,000	NA	NA			NA	NA	NA	<10,000

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a Total petroleum hydrocarbons in this water sample exceed the 15 µg/L stated for fresh water in ADEC's Water Quality Criteria 18AAC70 (ADEC 1989).
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-11. INACTIVE LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Inactive Landfill (LF11)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL
(DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample						Lab Blanks
					SW01					EB03	
Laboratory Sample ID Numbers					4428-1					4425-9	4428 4425
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L					µg/L	µg/L
Aluminum	17.4	100		<100-350 (<100-340)	<100 (<100)					<100	<100
Antimony	N/A	100	6	<100 (<100)	<100 (<100)					<100	<100
Arsenic	5.3	100	50	<100 (<100)	<100 (<100)					<100	<100
Barium	1.2	50	2,000	<50-93 (<50-91)	350 (350)					<50	<50
Beryllium	N/A	50	4	<50 (<50)	<50 (<50)					<50	<50
Cadmium	1.7	50	5	<50 (<50)	<50 (<50)					<50	<50
Calcium	34.5	200		4,500-88,000 (4,100-86,000)	97,000 (97,000)					250	<200
Chromium	3.29	50	100	<50 (<50)	<50 (<50)					<50	<50
Cobalt	N/A	100		<100 (<100)	<100 (<100)					<100	<100
Copper	2.3	50	1,300	<50 (<50)	<50 (<50)					<50	<50
Iron	25	100		180-2,800 (<100-1,600)	1,500 (420)					<100	<100
Lead	6.6	100		<100 (<100)	<100 (<100)					<100	<100

☐ CT&E Data.
N/A Not available

TABLE G-11. INACTIVE LANDFILL ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Inactive Landfill (LF11)

Matrix: Surface Water
Units: µg/L

METALS ANALYSES: TOTAL
(DISSOLVED)

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Range from 7 DEW Line Installations	Environmental Sample						Lab Blanks
					SW01					EB03	
Laboratory Sample ID Numbers					4428-1					4425-9	4428 4425
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L					µg/L	µg/L
Magnesium	47.8	200		<5,000-53,000 (2,600-54,000)	41,000 (40,000)J					<200	<200
Manganese	1.24	50		<50-510 (<50-120)	220 (200)					<50	<50
Molybdenum	N/A	50		<50 (<50)	<50 (<50)					<50	<50
Nickel	5.5	50	100	<50 (<50)	<50 (<50)					<50	<50
Potassium	1,154	5,000		<5,000 (<5,000)	5,700 (<5,000)					<5,000	<5,000
Selenium	62.4	100	50	<100 (<100)	<100 (<100)					<100	<100
Silver	2.6	50	50	<50 (<50)	<50J (<50)					<50	<50
Sodium	27.7	250		8,400-410,000 (8,200-450,000)	63,000J (64,000)					420	<250
Thallium	.57	5	2	<5 (<5)	<5 (<5)					<5	<5
Vanadium	1.8	50		<50 (<50)	<50 (<50)					<50	<50
Zinc	8.2	50		<50 (<50)	<50 (<50)					<50	<50

☐ CT&E Data.
N/A Not available.
J Result is an estimate.

TABLE G-12. MODULE TRAIN ANALYTICAL DATA SUMMARY

Installation: Point Lonely
Site: Module Train (SS12)

Matrix: Soil/Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks			Lab Blanks	
					S01	S02	S03	SD01-1	AB01	EB01	TB01		
Laboratory Sample ID Numbers					502	506	504 4355-1	516	906	530/534 4357-1	528 4357-8	#5-82793 #3&4-82593 4357	#5-82593 #1&2-82593 4355
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	µg/L
DRPH	5-6	50-60	500[a]	<190[b]-150J[b]	<50[b]	<50[b]	<50[b]	<60[b]	NA	<1,000[b]	NA	<1,000	<50
GRPH	0.2	2	100	<20J[b]-27J[b]	<2J[b]	<2J[b]	<2J[b]	<2J[b]	<100J[b]	<50J[b]	<100J[b]	<50	<1
RRPH (Approx.)	10-12	100-120	2,000[a]	<180-<670	<100	<100	560	<120	NA	<2000	NA	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<1.0-2.7J	<0.10	<0.10	<0.10	<0.10					
Benzene	0.002	0.02	0.5	<0.04-<0.3	<0.02	<0.02	<0.02	<0.02	<1	<1	<1	<1	<0.02
Toluene	0.002	0.02		<0.2-0.5	<0.02	<0.02	<0.02	<0.02	<1	<1	<1	<1	<0.02
Ethylbenzene	0.002	0.02		<0.2-0.2	<0.02	<0.02	<0.02	<0.02	<1	<1	<1	<1	<0.02
Xylenes (Total)	0.004	0.04		<0.4-2.0J	<0.04	<0.04	<0.04	<0.04	<2	<2	<2	<2	<0.04
HVOC 8010	0.002	0.02		<0.04-<0.3	<0.02	<0.02	<0.02	<0.02	<1	<1	<1	<1	<0.02
VOC 8260													
Styrene	0.020	0.020		<0.300-<0.500	NA	NA	0.08	NA	NA	<1	<1	<1	<0.020
SVOC 8270	0.200	4.00		<5.00-<30.0	NA	NA	<4.00	NA	NA	<29	NA	<10	<0.200

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-12. MODULE TRAIN ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely Site: Module Train (SS12)	Matrix: Soil/Sediment Units: mg/kg										
Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blank	Lab Blanks	
					2S04-1	2SD02			EB08		
Laboratory Sample ID Numbers					1762	1763			1774 4626-13	#6-9993 4626	#5-9693
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg			µg/L	µg/L	mg/kg
DRPH	7-25	70-250	500[a]	<190[b]-150J[b]	<250[b]	<70[b]			289J[cd]	<200-<1,000	<50
RRPH (Approx.)	14-50	140-500	2,000[a]	<180-<670	<500	<140			<2,000	<2,000	<100

□ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH concentrations reported for these samples are equivalent to diesel range organics (DRO) as defined by ADEC.
c This sample was analyzed by F&B also; DRPH were detected at <1,000[b] µg/L.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE G-12. MODULE TRAIN ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Module Train (SS12)

Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks				Lab Blanks
					SW01	2SW02		AB01	EB01	EB08	TB01	
Laboratory Sample ID Numbers					508 4355-2	1761		906	530 534 4357-1	1774 1776 4626-13	528 4357-8	#6-9993 #3&4-82593 4355/4357/4626
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L		µg/L	µg/L	µg/L	µg/L	µg/L
DRPH	100	1,000		<1,000[b]	NA	<1,000[b]		NA	<1,000[b]	289J[cd]	NA	<200-<1,000
GRPH	5	50		<100J[b]	<100J[b]	NA		<100J[b]	<100J[b]	<20[c]	<100J[b]	<50
RRPH (Approx.)	200	2,000		<2,000	NA	<2,000		NA	<2,000	<2,000	NA	<2,000
BTEX (8020/8020 Mod.)												
Benzene	0.1	1	5	<1	<1	NA		<1	<1	<1	<1	<1
Toluene	0.1	1	1,000	<1	<1	NA		<1	<1	<1	<1	<1
Ethylbenzene	0.1	1	700	<1	<1	NA		<1	<1	<1	<1	<1
Xylenes (Total)	0.2	2	10,000	<2	<2	NA		<2	<2	<2	<2	<2
VOC 8260												
1,2-Dichloroethane	1	1	5	4.9-7.9	3.1B	NA		NA	3.9	<1	<1	<1
Toluene	1	1	1,000	<1	1.6	NA		NA	<1	<1	<1	<1
SVOC 8270	10	11		<10.2-<11	<11	NA		NA	<29	NA	NA	<10

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
B The analyte was detected in the associated blank.
J Result is an estimate.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.
c This sample was analyzed by F&B also; DRPH and GRPH were detected at <1,000[b] and <50[b] µg/L, respectively.
d The laboratory reported that the EPH pattern in this sample was not consistent with a middle distillate fuel.

TABLE G-12. MODULE TRAIN ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Module Train (SS12)

Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples			Field Blanks				Lab Blanks
					SW01	2SW02		AB01	EB01	EB08	TB01	
Laboratory Sample ID Numbers					512 514 4355-2	1761		906	530 534 4357-1	1774 1776 4626-13	528 4357-8	4355 4357
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L		µg/L	µg/L	µg/L	µg/L	µg/L
TOC	5,000	5,000		25,200-28,700	43,700	NA		NA	<5,000	NA	NA	<5,000
TSS	100	200		5,000-12,000	64,000	NA		NA	NA	NA	NA	<200
TDS	10,000	10,000		253,000-424,000	615,000	NA		NA	NA	NA	NA	<10,000

☐ CT&E Data.
NA Not analyzed.

TABLE G-13. HANGAR PAD AREA ANALYTICAL DATA SUMMARY

Installation: Point Lonely — Matrix: Soil/Sediment
Site: Hangar Pad Area (SS13) — Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples				Field Blanks			Lab Blanks	
					S01	SD01	SD02	SD03	AB02	EB04	TB04		
Laboratory Sample ID Numbers					1106	1104 4429-1	1108	1102	1094	1098 1100 4426-4	1092 4426-3	#5-83093 #5-82893 #1&2-82893 4426	#6-82993 #3&4-83193 #1&2-82893 4429
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	µg/L	µg/L	µg/L	mg/kg
DRPH	5-10	50-100	500[a]	<190[b]-150J[b]	<50[b]	<100[b]	190J[b]	<80[b]	NA	<1,000J[b]	NA	<1,000	<50
GRPH	0.2-0.4	2-4	100	<20J[b]-27J[b]	<2J[b]	<4J[b]	40J[b]	<2J[b]	<50[b]	<50J[b]	<50J[b]	NA	<2
RRPH (Approx.)	10-19	110-190	2,000[a]	<180-<670	<110	<190	220	<110	NA	<2,000	NA	<2,000	<100
BTEX (8020/8020 Mod.)			10 Total BTEX	<1.0-2.7J	<0.10	<0.20	<0.64	<0.10					
Benzene	0.002-0.02	0.02-0.2	0.5	<0.04-<0.3	<0.02	<0.04	<0.2	<0.02	<1	<2J	<6J	<1	<0.02
Toluene	0.002-0.02	0.02-0.2		<0.2-0.5	<0.02	<0.04	<0.2	<0.02	<1	<2J	<4J	<1	<0.02
Ethylbenzene	0.002-0.02	0.02-0.2		<0.2-0.2	<0.02	<0.04	<0.2	<0.02	<1	<2J	<3J	<1	<0.02
Xylenes (Total)	0.004-0.04	0.04-0.4		<0.4-2.0J	<0.04	<0.08	<0.4	<0.04	<2	<2J	<3J	<2	<0.04
HVOC 8010	0.002-0.004	0.02-0.04		<0.04-<0.3	<0.02	<0.04	<0.02	<0.02	<1	<1	<1	NA	<0.02
VOC 8260	0.020	0.030		<0.04-<0.3	NA	<0.030	NA	NA	NA	<1	<1	NA	<0.020
SVOC 8270	0.200	2.70-6.27	8,000	<5.00-<30.0	NA	<2.7-6.27U	NA	NA	NA	<26	NA	<10	<0.200-1.610
TOC				99,600-473,000	NA	19,600	NA	NA	NA	<5,000	NA	<5,000	NA

□ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
U Compound is not present above the concentration listed.
a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.

TABLE G-13. HANGAR PAD AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Hangar Pad Area (SS13)

Matrix: Sediment
Units: mg/kg

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blank	Lab Blanks	
					2SD04	2SD05	2SD06			EB08		
Laboratory Sample ID Numbers					1764	1765	1766			1774	#6-9993	#5-9693
ANALYSES	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg			µg/L	µg/L	mg/kg
DRPH	6-8	60-80	500[a]	<190[b]-150J[b]	<80[b]	<80[b]	<60[b]			289J[cd]	<1,000	<50
RRPH (Approx.)	12-20	120-200	2,000[a]	<180-<670	<200	<200	<120			<2,000	<2,000	<100

- ☐ CT&E Data.
- ▩ F&B Data.
- NA Not analyzed.
- J Result is an estimate.
- a The action levels for DRPH and RRPH are based on conversations with ADEC; final action levels have not yet been determined.
- b DRPH concentrations reported for these samples are equivalent to diesel range organics (DRO) as defined by ADEC.
- c This sample analyzed by F&B also; DRPH were detected at <1,000[b] µg/L.
- d The laboratory reported that the EPH pattern for this sample was not consistent with a middle distillate fuel.

TABLE G-13. HANGAR PAD AREA ANALYTICAL DATA SUMMARY (CONTINUED)

Installation: Point Lonely
Site: Hangar Pad Area (SS13)

Matrix: Surface Water
Units: µg/L

Parameters	Detect. Limits	Quant. Limits	Action Levels	Bkgd. Levels	Environmental Samples					Field Blanks			Lab Blanks
					SW01	SW02	SW03			AB02	EB04	TB04	
Laboratory Sample ID Numbers					1110 1112 4429-2	1114 1116	1118 1120			1094	1098 1110 4426-4	1092 4426-3	#5-83093 #1&2-82893 4429 4426
ANALYSES	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L			µg/L	µg/L	µg/L	µg/L
DRPH	20	200		<1,000[b]	<1,000J[b]	<1,000[b]	<1,000J[b]			NA	<1,000J[b]	NA	<1,000
GRPH	5	50		<100J[b]	<50J[b]	<50J[b]	<50J[b]			<50[b]	<50J[b]	<50J[b]	NA
RRPH (Approx.)	200	2,000		<2,000	<2,000	<2,000	<2,000			NA	<2,000	NA	<2,000
BTEX (8020/8020 Mod.)													
Benzene	0.1	1	5	<1	<1	<1	<1			<1	<2J	<6J	<1
Toluene	0.1	1	1,000	<1	<1	<1	3			<1	<2J	<4J	<1
Ethylbenzene	0.1	1	700	<1	<1	2	<1			<1	<2J	<3J	<1
Xylenes (Total)	0.2	2	10,000	<2	<2	4J	18J			<2	<2J	<3J	<2
HVOC 8010	0.1	1		<1	<1	<1	<1			<1	<1	<1	NA
VOC 8260	1	1		<1	<1	NA	NA			NA	<1	<1	<1
SVOC 8270	10	22		<10.2-<11	<22	NA	NA			NA	<26	NA	<15
TOC	5,000	5,000		25,200-28,700	34,600	NA	NA			NA	<5,000	NA	<5,000
TSS	100	200		5,000-12,000	8,500	NA	NA			NA	NA	NA	<200
TDS	10,000	10,000		253,000-424,000	846,000	NA	NA			NA	NA	NA	<10,000

☐ CT&E Data.
▩ F&B Data.
NA Not analyzed.
J Result is an estimate.
b DRPH and GRPH concentrations reported for these samples are equivalent to diesel and gasoline range organics (DRO and GRO) as defined by ADEC.